creative computing

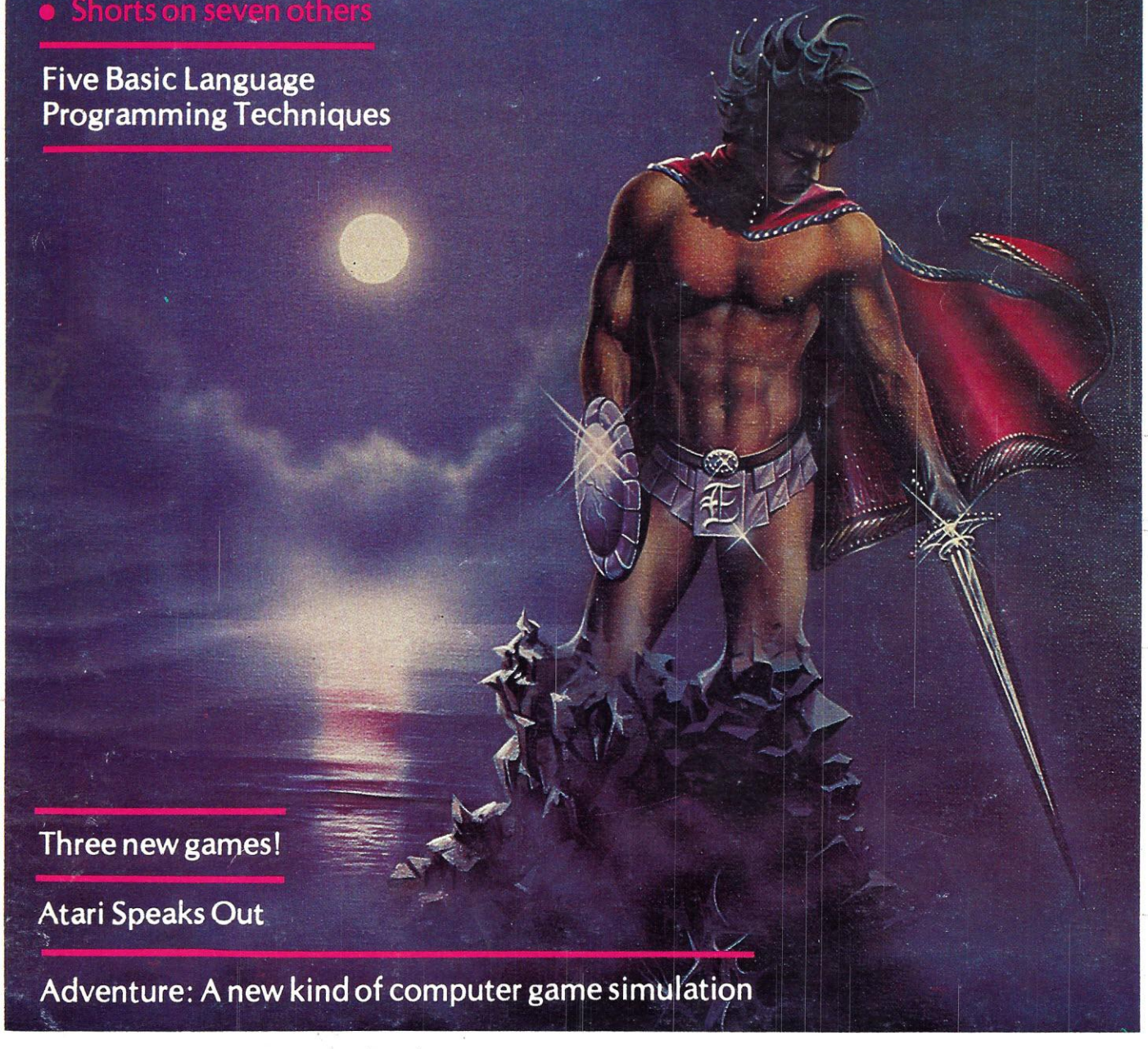
August 1979
vol 5, no 8
$2.00

the #1 magazine of computer applications and software

Artificial Intelligence: Can computers think?

New computers:
- Texas Instruments 99/4
- Radio Shack TRS-80 Model II
- Shorts on seven others

Five Basic Language Programming Techniques



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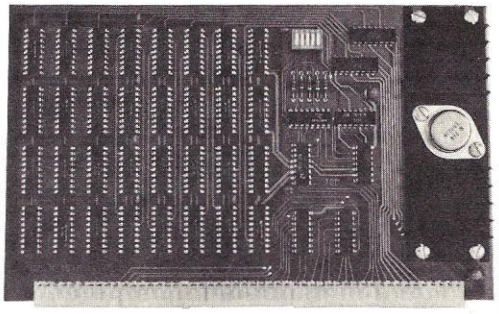

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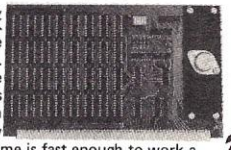

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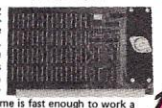

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The Cover

The painting on the cover is titled "Eternal Warrior" and is by the talented Paul Stinson who has appeared on our covers (Vol. 3, Nos. 3, 6; Vol. 4, No. 3). Would you like to be an eternal warrior? Then turn to the article on Adventure, page 90.

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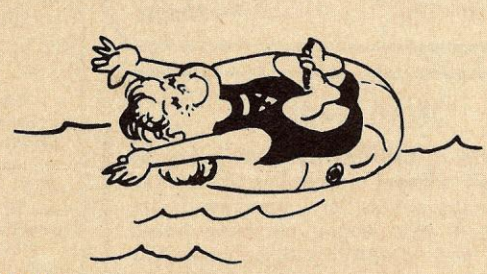

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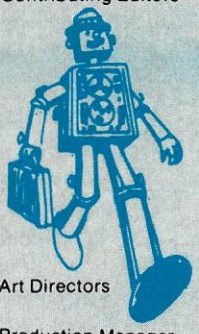

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CIRCLE 176 ON READER SERVICE CARD

Input/ Output

So Much For Army Recruiting Posters

Dear Editor:

I got a big laugh out of the picture (circa 1946) on page 100 of the May issue, showing the fresh young GI playing with the ENIAC computer. In the winter of '51 - '52 I was a fresh young GI at Aberdeen Proving Ground learning about computers (analog) for gun fire control. My only exposure to ENIAC occured in the wee hours of cold mornings, when I was made to march around the Ballistic Research Labs with a gun on my shoulder, in case any dirty Commies tried to paddle a canoe up Chesapeake Bay and attack the monster.

The computer certainly was active 24 hours a day, as important looking people would come and go at all hours of the night. None of them had red stars on their hats, so I never got to shoot anyone.

They never even let me look at ENIAC.

Ken Barbier
Borrego Engineering
P.O. Box 1253
Borrego, Springs, CA 92004

More FORTRAN?

Dear Editor:

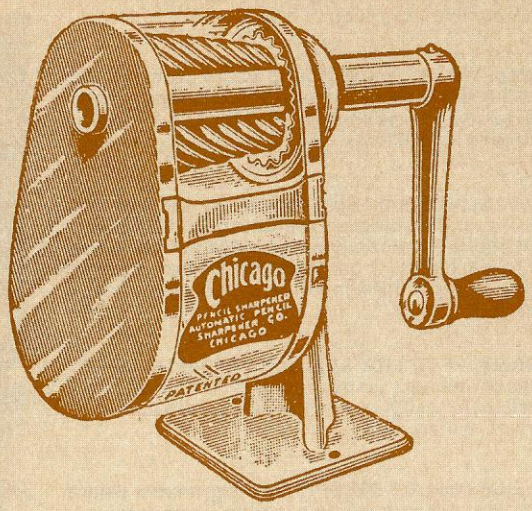
I was persuing your May, 1979 issue of Creative Com puting and came across "Can You Follow Directions." I have been using a similar one for the eight years I have been teaching Data Processing. The major difference is that I do not have any verbal responses because, 1) it is too disruptive, and 2) it makes it too detectable as a joke.

I believe that direction number 20 is incorrect. It should read "do only points one and TWO." This way you are able to determine who cannot follow directions.

Further, I would like to lodge a strong protest. Every program you exhibit in your magazine is written in BASIC. My students write in RPG and FORTRAN. Many of them would like to use these programs but it takes too long to transcribe. Why don't you have some goodies in FORTRAN or RPG? Also, how about more in the area of education?

M.S. Weiner
29 West Lake Shore Drive
Rockaway, New Jersey 07866

In our four years of publication we have received only a handful of FORTRAN programs and none in RPG. Neither (especially RPG) is very user-oriented, structured, or widely used on microcomputers. Although we try to provide programs for all readers (including students and educators) we'd prefer to be progressive in our choice of programming languages and plan to run a few programs in PASCAL, possibly LOGO, the new DOD simulation language, SMALLTALK and others. You want others—then send articles! — *SN*



FORTRAN Star Wars

Dear Creative Computing,

This is John Swallow. I am 8 and know FORTRAN. I am writing about the game Starwars in your Sept-Oct 1978 edition.

When I was 7, I just got the magazine. Since I knew FORTRAN, I tried to translate BASIC to FORTRAN. It was like a cipher to me. It took me 4 months to get it going, but another month to get the random generator going. One more to modify. It works with these modifications —

1. Instead of typing the number of weapon, type name
2. At start put in a odd 9-digit number for random number generator
3. I changed your wrong 'dieing' to 'dying'. I now have it going. It takes 5 programs as following —
   Main Program — A10 (needs 24K)
   Subroutine — Part 1 (1st information)
   Subroutine — Part 2 (2nd information) subroutine — Part 3 (3rd information)
   Subroutine — XRAND
   Random Number Generator

I would like you to publish it. I now know BASIC and FORTRAN. I am learning RPG. I work on a IBM System/32.

John R. Swallow
316 W. College Ave.
Hartsville, SC 29550

John's program is very nicely done, but unfortunately it is 14 pages long and we just couldn't justify that much space for a Fortran Star Wars.

However, more to the point is that we receive many letters from readers complaining of a strange command in a Basic program that we have published that isn't available on their computer. They are frequently very irate that we do not describe every little nuance for every computer, particularly theirs.

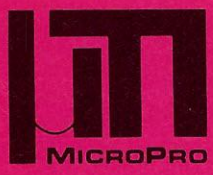
In my mind John Swallow sets a far better example of the approach readers should take toward any published software. [For more on this subject, see Bob Leedom's excellent letter in the June issue, pg. 12]. — *DHA*

Book Review

Dear Editor:

I was pleased to see my book, **BASIC Programming for Computer Literacy**, reviewed in the May 1979 issue of

Continued on page 10



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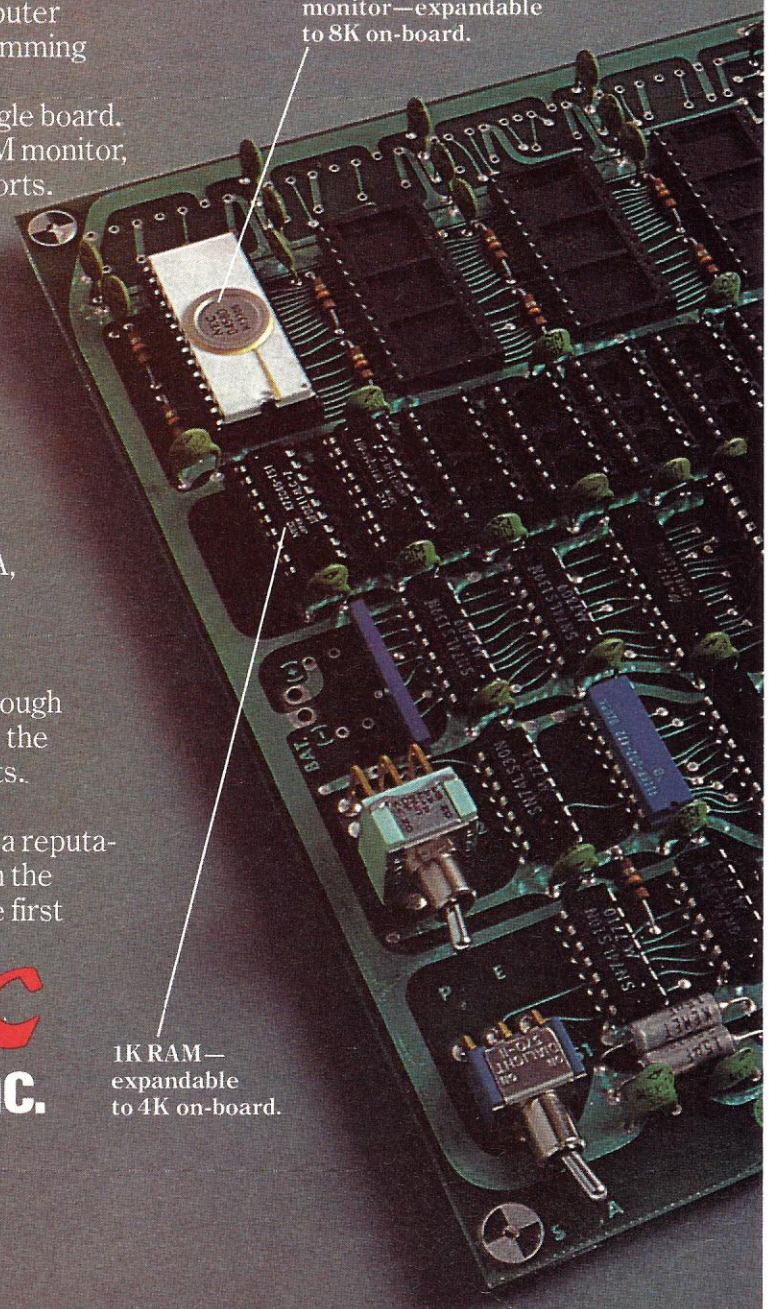

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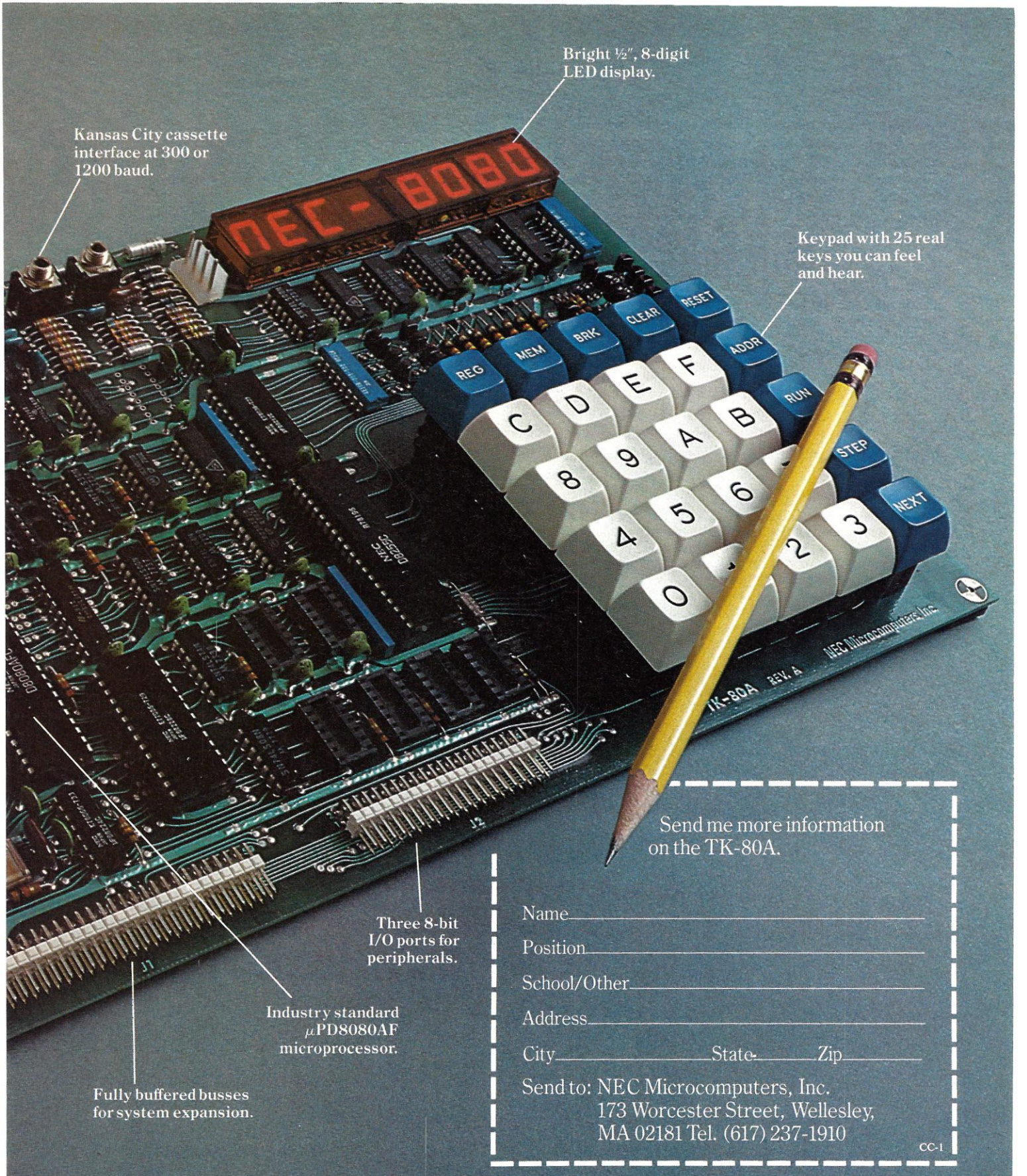

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Creative Computing. It seems to me, however, that the reviewer missed several of the key ideas underlying this book. First, the essence of computer programming is problem solving. The book is built around that idea, with the first two chapters titled Aids to Problem Solving, and Problem Solving Using Canned Programs. The reviewer failed to mention these.

Another key idea of computer programming is problem analysis via stepwise refinement, which is emphasized throughout the book. Finally, there is the overall concept of computer literacy, which is much more than just computer programming. The book is designed to do more for students than just give them an introduction to programming in BASIC.

David Morsund
University of Oregon
Dept. of Computer Science
Eugene, OR 97403

Vertical Printer Graphing

Dear Editor:

Vertical printer graphing does not require a separate decision matrix (April '79 issue, p. 146); each print line can be set up while scanning the array(s) of scaled Y values. The bar graph is particularly simple; once a given bar is "switched on" it stays on for the duration of the printing (see Fig. 2, p. 146).

A modified version of the program BARRETT6 (p. 151) is shown as an example.

Scott Davidson
1452 S. Third St.
Louisville, KY 40208

```
                XXXX
 XXXX           XXXX
 XXXX           XXXX
 XXXX           XXXX
 XXXX           XXXX                XXXX
 XXXX           XXXX                XXXX
 XXXX  XXXX     XXXX                XXXX
 XXXX  XXXX     XXXX                XXXX
 XXXX  XXXX     XXXX                XXXX                XXXX
 XXXX  XXXX     XXXX  XXXX          XXXX                XXXX
 XXXX  XXXX     XXXX  XXXX  XXXX    XXXX                XXXX
 XXXX  XXXX     XXXX  XXXX  XXXX    XXXX                XXXX
 XXXX  XXXX     XXXX  XXXX  XXXX    XXXX                XXXX
 XXXX  XXXX     XXXX  XXXX  XXXX    XXXX                XXXX

 ZOOK  JONES BOMB  FSTN  GOLD  MILT  TYRO  ROMB
```

```
10 DIM X(25)
20 DEF FNC(X)=INT(X/S*15+.5)
30 S=0
40 B$="      "
50 READ N
60 FOR I=1 TO N
70 READ X(I)
80 B$=B$+"      "
90 IF S>X(I) THEN 110
100 S=X(I)
110 NEXT I
120 FOR I=1 TO N
130 X(I)=FNC(X(I))
140 NEXT I
150 FOR I=15 TO 1 STEP -1
160 FOR J=1 TO N
170 IF X(J)<I THEN 210
180 REM---modify print line
    (simpler with string array or in FORTRAN)
190 B$=LEFT$(B$,6*J)+"XXXX  "+MID$(B$,6*J+7)
200 X(J)=0
210 NEXT J
220 PRINT B$
230 NEXT I
240 PRINT
250 PRINT "      ZOOK  JONES BOMB  FSTN
260 DATA 8                  GOLD  MILT  TYRO  ROMB"
270 DATA 450,300,480,200,150,350,0,200
280 END
```

PET Printer

Dear Editor:

In a few weeks I (and, I suspect, many other PET owners) will be marking a peculiar anniversary. Early in June one year will have gone by since I ordered Commodore's promised PET printer.

Last year about this time the local computer store was sure that it would have its PET 2020 printers within weeks. I decided to order one directly from Commodore. Having had speedy delivery of the PET itself the previous February, I figured I could count on having a printer too in, at most, two months (and save almost $25 of state sales tax as well).

No such luck. As the summer of '78 passed I learned I'd have to wait until September before my PET could produce hard copy. In the meantime the price of the printer rose from $595 to $695, though I was told that I needn't pay the extra $100 since my order had already been accepted.

It was a hard wait, but right through the middle of September various people at Commodore were assuring me that I could still expect delivery that month. But September came and went—no printer, but a new delivery forecast had issued from Palo Alto, "First quarter of '79." Not only need I wait three more months before passing into that time-frame, but the predictions were becoming less specific. First quarter of '79 meant anything from Jan. 1 to March 31.

They had me over a barrel and they knew it. Sure there were other printers that could operate with the PET, but they were all either too expensive, too limited (no graphics) or printed on funny-looking, expensive aluminized paper. There was nothing I could do but wait. The months passed slowly and finally it was January 1979—within the target period again. I was beginning to get excited again about the possible appearance of the 2020. Surely now, I thought, I could reasonably expect to see a printer sitting at my door in a matter of a few weeks at most.

Ah, but no. Toward the end of January I received a letter from some administrator at Commodore informing me that the 2020 had died a quick, but painful death. In its place—phoenix-line—rose two new models, the 2022 and the 2023, the latter of which, I was told, I could have for no additional cost (retail was now $849, a strangely unsymetrical figure) — in May!! May?! Another four month wait! The impulse to strangle someone was getting strong. However, I decided to wait one more time. The 2023 was, after all, a desirable piece of hardware—much more stylish than the old 2020 and with more impressive specifications. Besides, what could I do? I still wanted the graphics. And I was sure that if I cancelled out, mass production would begin the following week.

Well, I didn't and it didn't and it's now mid-May and I'm beginning to get that sinking feeling again. My best intelligence now points to about the middle of June as the start of production on the 2023, but I have my doubts.

Perhaps you can understand my skepticism. The appearance of Commodore's printers is an event which, like a mirage in the desert, recedes as one advances toward it. I am tempted, after all this time, to make sinister or paranoid conclusions as to Commodore's motives for all the delays, design changes and inflations of price.

I won't do this, but will only say that a wait of one year (possibly longer) for delivery of an announced peripheral is outrageous even by the standards of the computer industry. If, as Chuck Peddle once said (Creative Computing, Sept.-Oct., 1978, p. 38), that the battle (between microcomputer manufacturers) is now in the peripheral market, then may I suggest that Commodore is losing the war.

Phillip Schnell
918 W. Badger Road
Madison, WI 53713

Continued on page 12

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CIRCLE 102 ON READER SERVICE CARD

Superprimes!

Dear Editor:

The concept of a "Superprime" is sheer mathematical quackery. A prime number is a prime number regardless of what base it is expressed in. You state a definition of a superprime and give the number 7331 as an example. 7331 (base ten) is prime when expressed in any other base. But 7331 (base ten) is not necessarily a superprime when converted to another base. You seem to have made the definition of a superprime less rigorous than the definition of a prime itself.

Rob Cave
1711 Plymouth Drive
Irving, Texas 75061

All superprimes are primes, but not all primes are superprimes, as you point out. Therefore, the set of superprimes is a subset of the set of prime numbers. Because the definition of a superprime is based on its notation (and consequently the base in which it is written) a superprime in one base is not necessarily a superprime in another base, so each base has a different set of superprimes. Nevertheless for any given base the number of primes is greater than the number of superprimes. — *SN*

Cribbage Correction

Dear Editor:

Several readers have contacted me to report that my CRIBBAGE program (May 1979) will actually stoop so low as to cheat during the play of the hand. The computer will on occasion, after a "GO" situation, replay a card it has already played. The correction involves the addition of a line of code as follows:

```
As is:  2600 IF    C     1 THEN 2730
Add:    2605 IF    M5    1 THEN 2730
As is:  2610 FOR   J9 = 1 TO 4
```

I will also mention that there will be a problem in the unlikely event the computer ever has four 5's and has to play first; it has a rule to never play a 5 as the first card.

My apologies to those who might have spent frustrating hours searching for errors in the input of the program to their computer systems or trying to understand the logic of the program.

Sheppard Yarrow
6513 Farmingdale Court
Derwood, Md 20855

In Spite of Everything, The H8 is...

Dear Editor:

I think your reply to a letter by Leonard Root, Jr. in the May 1979 issue missed the mark a bit. Mr. Root was puzzled about the dearth of software and accessories for the Heath H8 computer by outside vendors, compared to units such as the TRS-80 and PET.

True, the Heath bus is different, but I don't think that's the problem. I feel sure that the main reason they designed their own bus is cost. It's much cheaper than the S-100, and has the side benefit of working better. The H8 bus avoids the high frequency problems of the older S-100 design, and is thus more reliable.

Consider also that both the TRS-80 and PET are non-standard, and yet there's no shortage of hardware for them.

I think the problem is simply sales volume. My guess is that the Radio Shack unit outsells the H8 by over 25 to one. Thus, there are far more of them in the field and a viable market for software and hardware vendors.

The most obvious reason for Heath's failure to dominate a market that should have been right down their alley is price. The minimum H8 system is not competitively priced. For example, to purchase an H8 system with comparable capability to the 8K PET would cost almost $1600 in kit form - about twice the cost of the PET. Few buyers can justify this difference in their minds when making a purchase decision.

Before I bought my H8 system I looked at all the competition, and was aware of the lack of software. But since my needs are specialized, I would have had to write most of my own anyhow. In my opinion, far more important than initial cost are things such as reliability, service and parts, and compatibility. Heath is a company I can depend on to be there next year when I may have a problem, and to be willing to help me. I've had very few problems with my system, but they have bent over backwards to fix them in a hurry. By buying all Heath equipment, I eliminated compatibility problems. Also, Heath's prices are competitive in a maximum H8 system (full memory, floppy, and printer).

The thing I like best about the H8 is that it always works. It doesn't crash, even with the many power surges and brownouts we have in Florida, and it doesn't mind the heat and humidity. I use my system, almost 24 hours per day, and it's never let me down. So I'm more than willing to suffer the disadvantages of owning Heath equipment.

Finally, Heath is beginning to recognize the desireability of software compatibility, and is now offering a Microsoft BASIC and FORTRAN, and is supporting a CP/M compatible operating system to be offered by another firm.

The H8 will never be as popular as the TRS-80, PET or APPLE, but in my opinion it's a better piece of equipment, and worth the extra cost.

Bill Phillips
6 Monterey Circle
Ormond Beach, Florida 32074
(904) 677-8587

Sorcerer Strings

Dear Editor:

Ken Barbier was incorrect when he stated in his billing program article (June, 79, p. 73) that the Sorcerer computer BASIC does not permit "string arrays." The Sorcerer BASIC does permit string arrays. What it does not permit is the CSAVE* of string arrays on tape. Only numerical arrays can be saved with this command.

With a little imagination and a knowledge of the Sorcerer's capabilities, however, strings and string arrays can be put on tape and read back into the computer—at 1200 baud, yet. I am presently writing up the procedure on how to do this.

Also, the problems that Dr. Weinshelbaum had with getting programs to run in his Sorcerer were most likely due to an inadequate conversion to the Sorcerer's requirements. One notable requirement is the use of a CLEAR command in the program if the total string space exceeds 50 bytes. For instance, if the number of string bytes incurred in the program is 500, then a CLEAR 500 (or greater) must be

Continued on page 14

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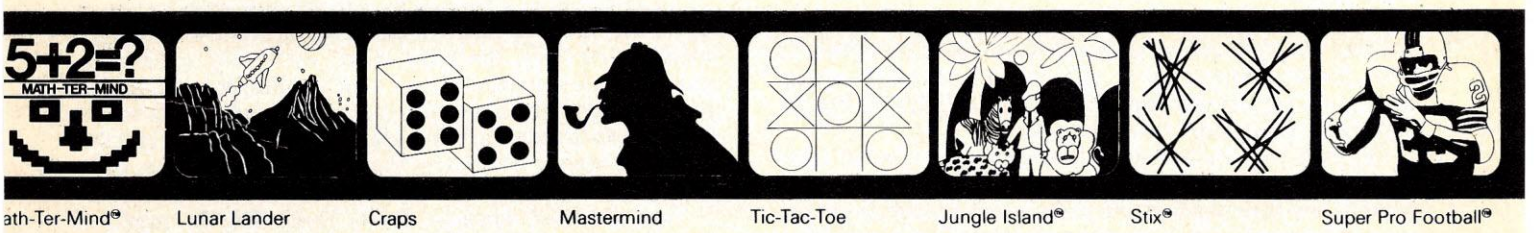

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CIRCLE 106 ON READER SERVICE CARD

issued early in the program. This command sets aside an appropriate amount of memory space for use in string storage.

David Persuitte
1707 Independence Ct.
Severn, MD 21144

Different Strokes for Different Folks

Dear Editor:

Thank you for your offer for me to continue my subscription to Creative Computing. I feel however that at this time the market has grown sophisticated and a magazine that features 1. review after review of word processing systems; 2. page after page of kiddie toys; 3. 19th century woodcuts relating only faintly to the subject matter; 4. short stories which follow the theme of "computer achieves consciousness and neat things happen thereafter"; 5. games, tricks and puzzles does not fill my needs as succinctly as some of the others.

Alex Funk
110 E. Lynch St.
Durham, NC 27701

P.S. Idols of computer art, CC578.100, was excellent/ Especially contrasted with articles by people who worshipped same idols!

Dear Editor:

I received your letter urging me to subscribe to Creative Computing about a year ago (when I was just getting into home computing) I was very unimpressed with Creative Computing — it was thin and lacking articles of interest.

Recently I picked up an issue; it was fantastic. Thick and juicy, with lots of meat in it. The next issue was the same. So I sent for three more years.

To summarize: the best way to sell Creative Computing is to put a copy into the hands of a home computing enthusiast.

DeWitt Brown
1650 9th Ave., S.E.
Rochester, MN 55901

P.S. The ads are GREAT!

Business Trials

Dear Editor:

This story of my trials and tribulations to get a computer running for my business may provide a plank for others to cross the treacherous sands of bad software, lousy service and a great amount of mumbo-jumbo the lads with "computer expertese" try to snow you under with.

My first shot is aimed at all the people who tried to snow me. I am a successful businessman with enough loot in my jeans to buy their product and if I'm smart enough to gather enough "long green" to buy a computer then I must be at least as smart as they are on many subjects of which they have no knowledge. When I asked them the time of day they tried to tell me how to build a watch!

Documentation has the aroma of an old sock. I've rewritten every word of instructions (after much thought and second-guessing) so that anyone with an eighth grade education could run these monsters the first time. Consider when the first model T came out. Many felt that before taking a drive a person had to understand "cubic inch displacement," "thermal efficiency," "flame propagation" and all the other goodies that make the wheels go round!

Now I will bore you with my findings on software, the necessary "evil" to make these little dumb boxes do something. One must realize these little black boxes can be turned out like proverbial sausages but, the old slow human brain must write the software. It appears the people smart enough to write software know very little about the outside world. Their lack of business sense is appalling to the point of "cookie flipping." There is a dearth of games but they don't seem to know anything about 2x4's, volts, set up time for concrete when it is 100 degrees in the shade, etc. Small businesses are like girls; all alike but still with enough difference that each one must be wooed with a different approach. Anyone thinking of a computer to get out of some work to do "a little fishin" is in for a shock. It will cause him more work because of the conversion to a computerized system and the possibility he will have to learn programming before seeing a return on his investment.

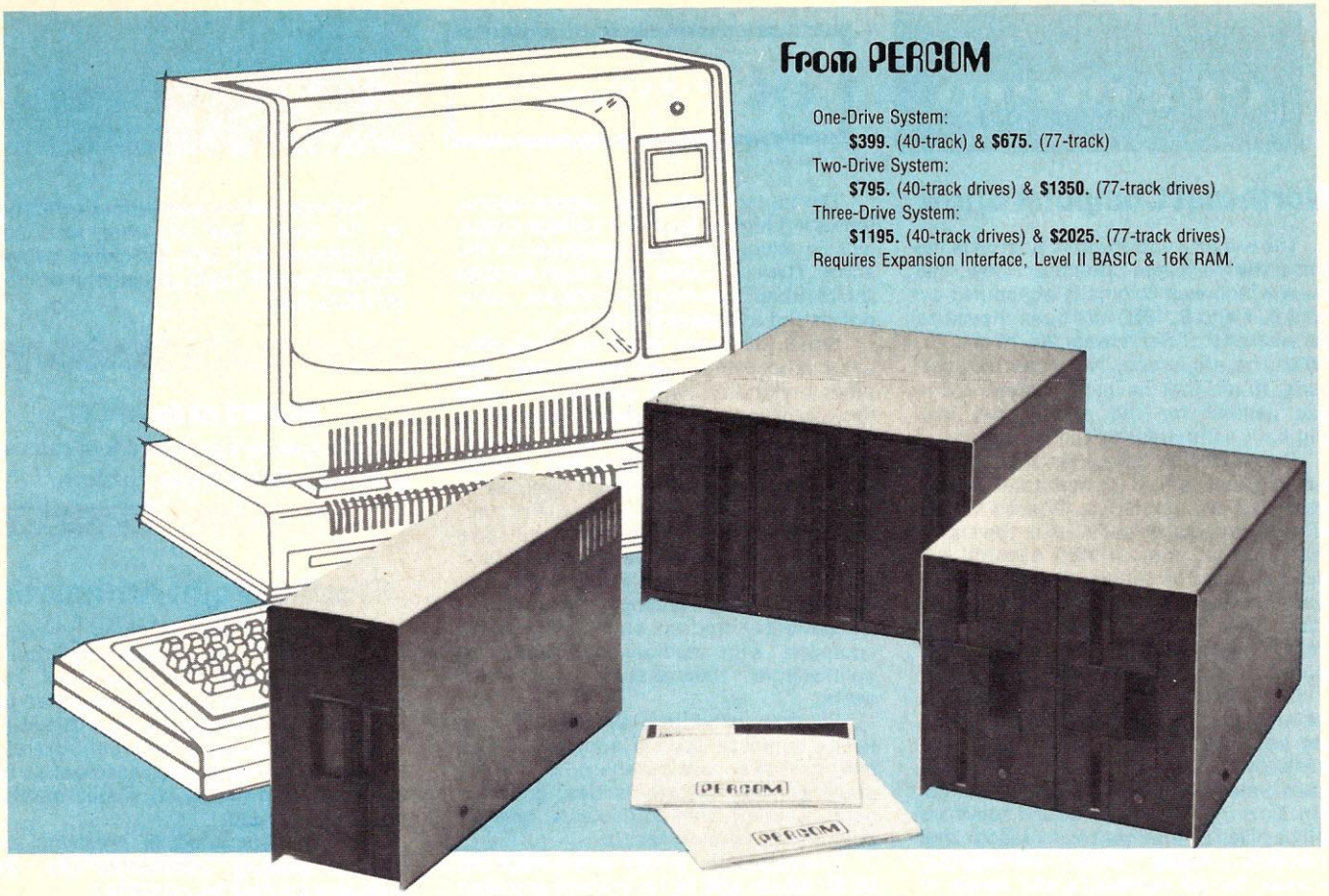
All this came about in the following fashion, early last year I succumbed to the wooing of Radio Shack, being a young innocent boy right from the farm I bought one, for better or worse. It didn't take me long to become dissatisfied with my new love. She couldn't give me a copy I could hold in my hands but this was not her fault, but being young and impetuous I decided to "bring one up my way." I then proceeded to assemble an H-11 by Heath. Again in my innocence I didn't know that a paper punch was a "prehistoric method of storing information"; now the people at Heath thought a six week wait was within reason to have a paper tape punch refitted with new solenoids that were bad when they were made. Well this ole farm boy told them in good loud words no business man was waiting that long to find out about the "crows in the corn." I must say after I got nasty their service got better, but I made at least one trip (120 miles round trip) some times two a week to keep this beast running. After seven months with six major operations I knew I wouldn't make it this year; meanwhile my voice began to sound like a old mother hog calling for her babies and they gave me my purchase price back. Their advertising had led me to believe that this unit would support a small business!!!

After the big problem with service I thought I would buy close to home; the nearest being a salesman for Ohio Scientific, to make this part short I had two C3-OEM's blow up in less than three months; since my past experiences with the H-11 was ringing in the gentleman's ears he was glad to give my money back, talk about the "gods of fortune" smiling down on this country hick, twice "across the barrel" and I got my money back.

I had just seen a year go by and my goal wasn't even in sight, only a lot of expense and disappointment, nothing I could eat or "buy the baby shoes with." My experience showed any computer could do what I wanted it to if it would stay running; I also knew the smaller the modules the easier and cheaper it would be to keep in operation, the more and the closer the dealers were to me the greater my advantage over these monsters became.

Aha came the dawning, Radio Shack TRS-80, maybe I should see what my first love is like. I find there are twenty-five dealers in the Chicago land area, two service centers within one hour driving time, floppy disks for $500 bucks each, CRT in a separate unit, keyboard separate, expansion interface separate, and classes being offered so I could send a few people to learn. I purchased 4 floppy drives and 2 complete TRS-80's with 48K. I know Radio Shack and I will be able to keep these operating, as a person in business expects his equipment to perform.

Eugene G. Wright
405 East Bates St.
Hebron, IN 46341



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Whether you need a single, 40-track TFD-100™ add-on or a three-drive add-on with 77-track TFD-200™s, you get more data storage for less money from Percom.

Our TFD-100™ drive, for example, lets you store 102.4K bytes of data on one side of a disk — compared to 80K bytes on a TRS-80* mini-disk drive — and 102.4K bytes on the other side, too. Something you can't do with a TRS-80* drive. That's almost 205K bytes per mini-disk.

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PATCH PAK #1™, our upgrade program for your TRSDOS*, not only extends TRSDOS* to accommodate 40- and 77-track drives, it enhances TRSDOS* in other ways as well. PATCH PAK #1™ is supplied with each drive system at no additional charge.

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To order add-on mini-disk storage for your TRS-80*, or request additional literature, call Percom's toll-free number: 1-800-527-1592. For detailed Technical information call (214) 272-3421.

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Percom *'peripherals for personal computing'*

Northeast Computer Show

The Hynes Auditorium in Boston is the site of the Northeast Computer Show. The show which was originally scheduled on April 6, 7 and 8, 1979 has been moved to the weekend of September 28, 29 and 30, 1979. The producers, Northeast Expositions, found that far more exhibit space was needed for the show than was originally estimated; hence the change.

The Northeast Computer Show will be the largest display of computer equipment ever assembled in Boston. There will be two separate sections to the show. The personal computering section will feature micro computers, small computer systems, business opportunities, electronic and video games, career and employment opportunities, educational exhibits, free seminars and lectures.

Exhibiters in this section will display the latest in personal computing hardware and software, computerized music synthesizers, computer amusements, computer-generated art, graphics and animation. Dozens of free lectures and seminars will be given by internationally recognized speakers, along with introductory classes, for all categories and levels of enthusiasts.

Computer clubs and organizations, including high school and college clubs, will be encouraged to participate in the show. There will also be special exhibits for children featuring calculators, computers and educational exhibits.

Small business systems, including word processing, data processing, and other peripherals will occupy the other section of the show. Free familiarization seminars, co-sponsored and co-promoted by business, trade and professional organizations, will be directed to small systems sales prospects. For neophytes, expert communicators will give concise comprehensive familiarization seminars, using laymen's language rather than technical terminology. The seminars will be held in modern, soundproof rooms equipped with audio-visual aids and comfortable theatre-style, cushioned seats.

To help exhibiters differentiate between business system show attendees and personal computerists, all show goers will wear colored badges; green for personal computing enthusiasts, blue for business system prospects.

The admission prices to the show are $5 for adults and $4 for college and high school students.

For more information about exhibiting in the show, call or write Northeast Expositions, Box 678, Brookline Village, Massachusetts 02147, telephone number (617) 522-4467.

SHAW'S PRINCIPLE:

Build a system that even a fool can use, and only a fool will want to use it.

Floating Point Arithmetic

The floating point working group of the IEEE Computer Society's Microprocessor Standards Subcommittee has been working on a proposed standard for microprocessor floating point arithmetic.

Several innovative and controversial proposals have been discussed but so far none has been widely circulated outside the working group.

Persons interested in receiving the current working documents for the various proposals may write to:

David Hough
PO Box 384
Wilsonville, OR 97070

Computer Art at Westlake Gallery

Computer - Artist: Artist - Computer, an international exhibition of computer generated drawings, graphics and sculpture by 15 artists will be held at Westlake Gallery at 210 East Post Road, White Plains, New York from June 28 through August 30. The gallery is open Monday through Saturday, 9:00 a.m. to 5:30 p.m.

International entries in the exhibition include a hooked rug by William Apgar of Canada, sculptures by Tony Longson of England and serigraphics by Herbert W. Franke of Germany. Large modular sculptures will be featured by Robert Mallary of the University of Massachusetts. Statements range from the elegant abstract graphics of Richard Helmick of Missouri and Ken Knowlton of New Jersey to the humorous prints of William Kolomyjec of Michigan.

A further dimension to the show is provided by Sculpture by Solid Photography. Solid Photography is an original process that has combined the art of photography with the technique of the computer in order to create three dimensional portrait sculptures which are amazingly accurate replications of their subjects. A window display and a special evening presentation on July 25 will explain the techniques involved.

INTRODUCTION TO PL/I AND STRUCTURED PROGRAMMING

Want to learn PL/I —Structured PL/I ? Know some PL/I and want to learn more ? Error-handling ? Debugging techniques ? Then ***INTRODUCTION TO PL/I AND STRUCTURED PROGRAMMING*** is for you. Covers an easy-to-learn subset of ANSI PL/I that will enable you to tackle a wide range of computer problems requiring numeric and string processing, plus a selection of the more advanced facilities. The entire syntax of the versatile subset is defined in only 3 pages of syntax diagrams. The book is suitable for self study, and may also be used in a first course in PL/I. Contains ten chapters and six appendices: 311 value-packed pages including 200 exercises and problems, comprehensive index, and bibliographies. An excellent reference document for only $5.00. (Add 80¢ postage.)

The interesting problems include mathmatical, simulation (maze, Gip bugs), graph-plotting, art, games (scrab-l-word, snakes and ladders, lots, etc), palindromes, cyphers, text analysis and more.

Outline of the PL/I features covered: fixed-point, floating-point, iterative DO statements including WHILE, conditionals, free-format (LIST) and EDIT-directed I/O, declarations, arrays (fixed and variable bounds), procedures and functions, built-in functions, computational error detection and correction, ON-units.

NEW SHAPES

by Julius Guest

is a collection of 110 original and fascinating computer-generated designs created by the author over an eight-year period. The designs are satisfying art creations in themselves and may evoke the responses that their titles suggest.

As each art piece is accompanied by a mathematical formulation and program, the reader may thus create his own "New Shapes" and derive as much enjoyment from them as the author obviously did.

The designs are reproduced in color (some in exciting solid reverse) on high quality art paper. Details: 174 pages, 28cm x 27 cm (11" x 10½") (At $11.99 U.S. that's only 11 cents per diagram !) Add $1.20 postage.

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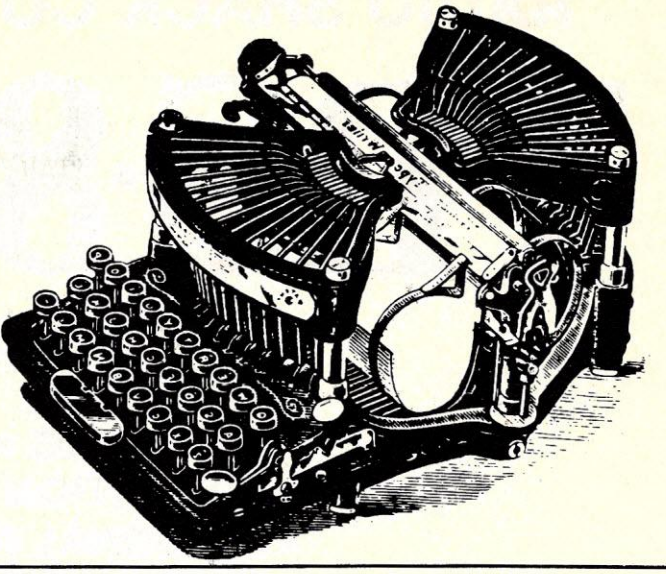
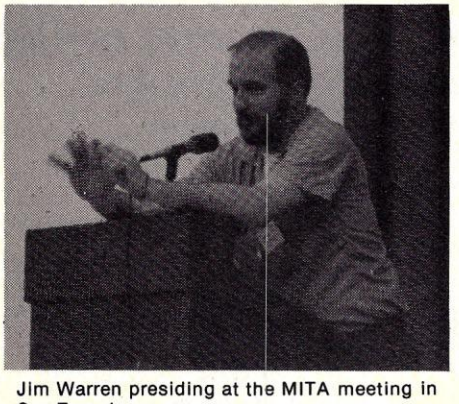
Editorial

John Craig



Jim Warren: What's He Up To?

In the early days of 1976, Jim Warren became editor of a new publication, **Dr. Dobb's Journal of Computer Calisthenics & Orthodontia**. He has since left Dr. Dobb's, and is now publishing the **Intelligent Machines Journal**. In 1977, together with Bob Reiling, editor of the bay-area Homebrew Computer Club newsletter, he put together the first of a successful string of West Coast Computer Faires.



Jim Warren presiding at the MITA meeting in San Francisco.

Jim is a pioneer in this field and he's made a number of significant contributions. He is also somewhat of an activist in other areas and is currently involved with the California Energy Initiative (Box 7361, Menlo Park, CA 94025). During the last year, Jim has become involved with two new computer projects that I thought you'd like to hear about...and perhaps get involved too.

Microcomputer Industry Trade Association (MITA)

As a result of meetings at three conventions last year an industry trade association, MITA, was formed. Its goal is to bring retailers, manufacturers, distributors and publishers together in an association to meet and solve common problems (such as software compatibility, interface standards, warranties, dealer/manufacturer relations, scheduling of trade shows, etc.). Jim Warren was instrumental in getting those preliminary meetings going and, probably because of his involvement, was elected president of the association. Since Jim puts on one of the biggest computer shows in the industry, there were a number of people who felt it was inappropriate for him to be president of an organization which was going to be coordinating shows. As a result of that, and other considerations, Jim announced at the recent MITA meeting held at the 4th West Coast Faire that he was stepping down.

I was impressed with the "meat" and significance of the topics brought up at that meeting (which was the first I had ever attended). However, I felt that more time should have been alloted to discussing some of the issues. No one likes to sit through a meeting like that for hours...but it appears that one hour isn't long enough.

The World Power Systems situation was one of the issues discussed. The general concensus from the audience was that the whole problem should be dumped into the laps of the magazine publishers. Since the magazines were burned as badly as anyone on this fraud, I'm sure we will be checking things more carefully in the future. One thing is for sure...if "Colonel Winthrop," or anyone like him, tries such an operation again, he better be **very** sophisticated.

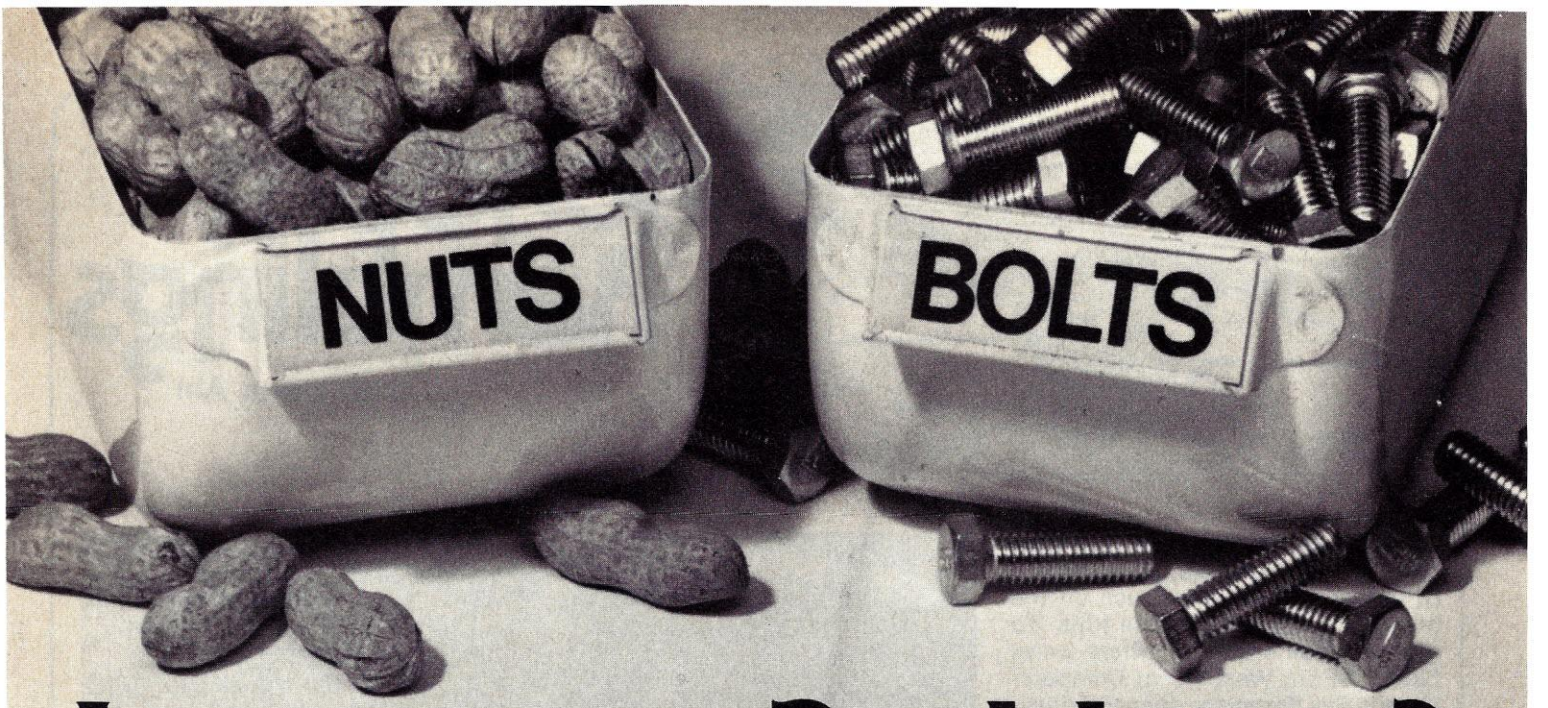
Most of the people attending the MITA meeting in San Francisco were not members. Someone asked for a show of hands of those who were seriously considering joining. Those raised hands are shown in Photo 1. I'd like to see the association grow into a strong and viable voice within the personal computing industry. When all the companies who manufacture, program and sell these things get together to solve common problems, we will all benefit.

MITA meeting in San Francisco.

Digicast

As though he didn't have enough irons in the fire, Jim Warren is also th director of The Digicast Project. This is a system, which is currently being made operational in the San Francisco Bay area, for transmitting digital data through an FM broadcast station. The signal will be received through a normal FM receiver then sent through a demodulator (which costs less than $100) and then onto the screen of a home computer system.

Some of the applications include receiving national and international news, stock quotes, sports results, special-interest news (e.g., computers, electronics, etc.), theatre and entertainment listings and advertising (both classified and display). Sounds interesting, doesn't it? We're going to have a full-length article on the system in the near future...stay tuned. □



Inventory Problems?

Are you having trouble keeping the right nuts and bolts in stock? Since even a simple mistake can cost you time and money, a good inventory system should do more than just count parts. It should tell you exactly what you need, when you need it, where to get it, and how much it will cost.

The MSI Inventory System Seven enables you to maintain a versatile data base for controlling inventory. It lists part number, description, quantity on hand, vendor, cost, selling price, optional pricing, usage levels for previous month, present month, and year-to-date, and much more.

When quantity on hand items reach minimum levels, the System Seven compiles an automatic reorder list. This list can be generated by specific vendor as well as a complete listing of all materials to be ordered.

In addition to the item listing, the Inventory System Seven "bill of materials" provides you with a complete inventory of items used in the manufacture of subassemblies and complete products. It also contains other cost items such as labor costs, total raw materials costs, and miscellaneous costs.

The MSI Inventory System Seven is built around the versatile MSI 6800A Computer with 56K of RAM. An integral dual mini-floppy memory gives you an additional 630K of memory and makes inventory control fast and efficient. The System Seven will interface with any industry standard CRT, and you have the option of both a "daisy wheel" word processor for high quality document preparation and a dot matrix printer for high speed production.

The System Seven can be expanded to handle all your data processing needs or you can select one of nine other MSI systems now available for business, industrial, scientific, educational, and personal applications.

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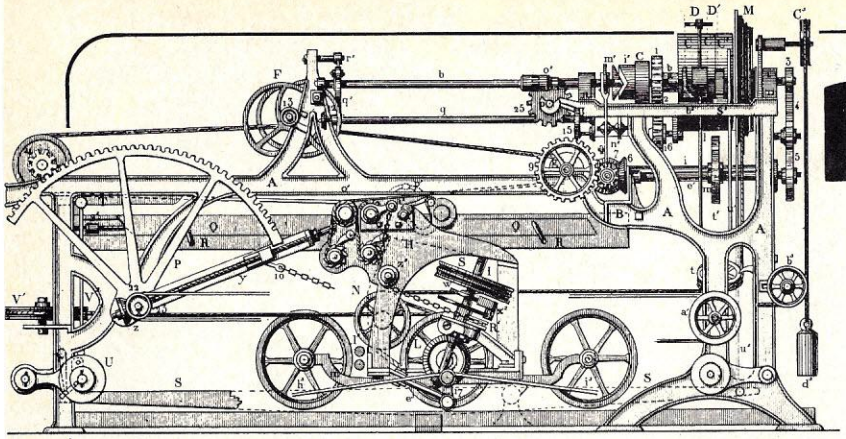


Random Ramblings

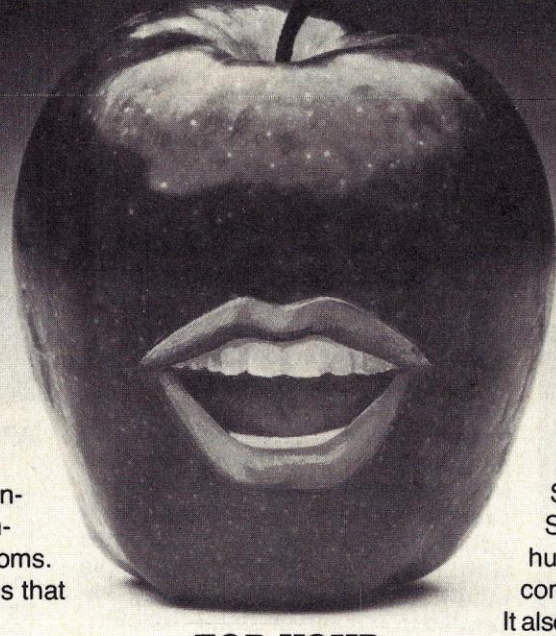
With David Ahl

Since I've rambled far and wide these last few months, this column, of necessity, can only touch on the highlights of some of these trips. To give you some idea of where we've been, the 5th West Coast Computer Faire in San Francisco opened Friday, May 11. Following the Faire, I drove down the coast from San Francisco to Los Angeles, stopping in for an interview with Gary Muhunen of Mountain Hardware. Further down, I stopped off at Lompoc to visit with John Craig. Four days after getting back from that trip, I took off again for Clemson, South Carolina to speak at their Microcomputer Conference. Concurrently, with that we were setting up our exhibit at the Business and Personal Computer Expo in Philadelphia, May 23-25. A week later found me flying to Chicago and on to Kenosha to give the awards address at "Computer Faire 3" at the University of Wisconsin/Parkside. The next day was the opening of the Consumer Electronics Show in Chicago. I stayed there Sunday and Monday, June 3 & 4, flying Monday night to New York to attend the National Computer Conference on June 5, 6, and 7. Those of you who were at NCC know that we had not one, not two, but three separate exhibit areas. We had one booth in the personal computing area (Sheraton Centre), one in the professional area (Coliseum), and we were one of ten manufacturers and software vendors that were invited to display in the NCC-sponsored Hands-On Exhibit area. I served on one panel and gave a presentation "Computer Games for Education" on Tuesday and then on Thursday delivered a paper "How to Write a User-Oriented Program." Several other people from Creative Computing including Ann Corrigan, John Craig, and Burchie Green also presented papers or served as panel moderators. Between CES and NCC, I attended 14 press conferences or new product introductions and an uncounted number of receptions and meetings. After weeding out unwanted literature I came home with a stack 15½ inches high. Needless to say, I can only write about a small fraction of the products introduced and the new developments in this column. However, you will be reading about most of them in the coming issues of Creative Computing.

As I predicted several years ago, there were more significant introductions for the consumer market or the personal computing market at the Consumer Electronic Show (and also at the Toy Fair earlier in the year) than there were at the National Computer Conference. Texas Instruments, for example, showed their new computer at the Consumer Electronics Show and, although they were an exhibitor at the National Computer Conference, did not show their new computer there. Mattel, Atari, Interact, CyberVision, and APF all showed new computers at the CES; none of them were at the NCC. Some manufacturers spread themselves thin and

ANOTHER FIRST FROM MOUNTAIN HARDWARE.

SUPERTALKER.



FOR YOUR APPLE II

GIVE VOICE TO YOUR APPLE.
SuperTalker allows you to add the dimension of human speech output in your computer programs. Add voice to games. Program verbal prompting for the operator of your business system. Use verbal warnings under program control as an enunciator in commercial security or control rooms. Create educational programs that verbally coach the student.

THE SUPERTALKER SYSTEM.
SuperTalker is a new Mountain Hardware peripheral system which allows the Apple II computer to output exceptionally high quality human speech through a loudspeaker under program control. Output may also be directed through any P.A. or stereo system. Initially, spoken words are digitized into RAM memory through the system microphone. Speech data in RAM may then be manipulated like any other stored data.

A COMPLETE PACKAGE.
The SuperTalker peripheral system consists of: The SuperTalker peripheral card which plugs into a peripheral slot on the Apple II; a microphone; a loudspeaker; easy-to-use operating software and documentation; plus, two ready-to-run SuperTalker programs.

OPERATING SYSTEMS.
In order to achieve maximum utility using SuperTalker, the SuperTalker Disk Operating System permits output of human speech under program control with direct I/O routines. It also provides a preparation program which permits the creation of voice files on diskette. BASIC program routines are provided which require only one-line statements to output a word or phrase. Routines also support cassette storage.

TEACH YOUR COMPUTER TO TALK.
For $279 assembled and tested, SuperTalker gives your Apple II a voice in the matter.

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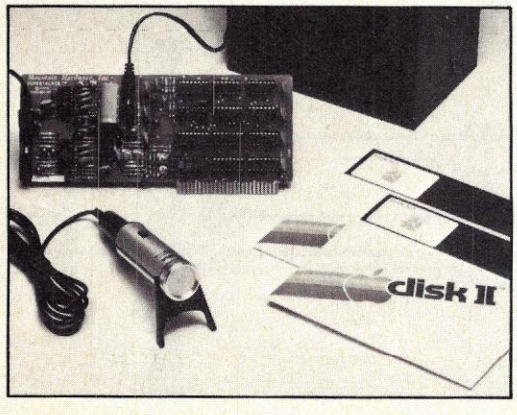

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300 Harvey West Blvd., Santa Cruz, CA 95060
(408) 429-8600

Sounds super.

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Ramblings, con't...

exhibited at both shows. Among them were Ohio Scientific (with lavish booths and receptions at both shows), Exidy Sorcerer, RCA, and Apple (although Apple was not an exhibitor at CES they did have a demonstration suite and a very posh reception at the Playboy Club). This column will focus mainly on the new products and developments announced at the CES. We'll mention one or two NCC items but next month we'll bring you our extensive coverage of the NCC show.

Attendance at CES and NCC was unbelievable — CES over 55,000 and NCC nearly 80,000! For more information on any of the products mentioned in this column, circle the indicated number on the Reader Service Card.

Texas Instruments

As expected TI introduced one of a projected family of three computers, the **TI-99/4**. Contrary to some expectations, it does not use bubble memory or any other significant new technology. It does use plug in ROM modules instead of tape cassettes or floppy discs, although both will be available as options. Since the FCC did not grant TI permission to employ an RF modulator of higher radiation levels than are allowed today, the 99/4 is sold only with a color monitor. This brings the starting price to the non-breakthrough level of $1150. (A complete profile of the 99/4 can be found elsewhere in this issue.)

Texas Instruments: Reader Service No. **250**

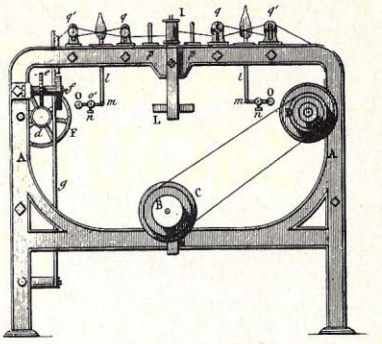
Ohio Scientific

Ohio Scientific introduced a top-of-the-line personal computer, the **Challenger C4P MF**. Features include a 2048 character display (32 x 64) with 16 colors and an effective graphics resolution of 256 by 512 points. The standard computer runs twice as fast as existing competitive models including earlier Ohio scientific models. (Even faster operation is possible with the GT option). The C4P MF was designed as a large memory capacity mini-floppy based computer. The standard machine comes with 24K static RAM, and a single mini-floppy. It can be directly expanded to 48K and two mini-floppies.

The computer also features a line printer interface, modem interface, a full keyboard with lower case and advanced disk based software including an Information Management System, Word Processor and a library of program development tools.

We were impressed with the spectacular color graphics and high speed animation. Sound output, a D/A converter for music and voice output, joystick interfaces, and real-time clock open a nice range of educational and game possibilities. Another nice feature is the home control operating system with Foreground-Background operation, an AC remote control interface, and a home security and fire alarm interface.

Ohio Scientific: Reader Service No. **251**

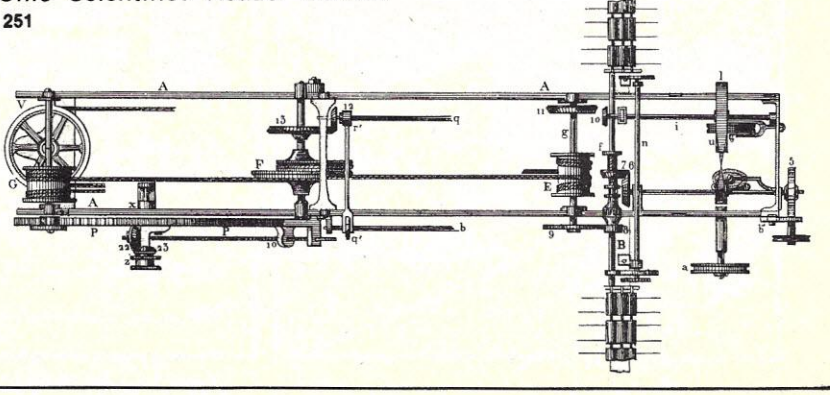


APF Electronics

APF's new personal computer, **The Imagination Machine** is claimed to be the only computer at a suggested list price of $499 which includes color graphics and expandable options. At a high resolution, the color graphics consist of 128 x 192 characters with up to 8 color variations. The core unit is the MP 1000 video game which is set into a larger case housing a keyboard, cassette deck and speaker.

Standard features include 10K ROM and 9K RAM memory, 53 key keyboard with a unique shifted "BASIC Keywords" button, two game-style controllers, 32 characters x 16 lines screen format, and cassette tape deck with digital and audio information on record or playback. The Imagination Machine will also have a built-in music synthesizer with a range of three octaves including sharps and flats.

APF: Reader Service No. **252**



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FOR THE PERSONAL COMPUTERIST

If companies or individuals are part of the personal computing industry, they will be exhibiting at the Northeast Personal & Business Computer Show. And if you are into computing at all, you'll want to attend the show to meet and talk with the hundreds of manufacturers, distributors and retailers showcasing their new 1980 micro, mini, and small computer systems.

You'll see them all, Radio Shack, Texas Instruments, Pet, RCA, Compucolor, Heathkit, and many, many more. All of the major terminal and peripheral people will be represented, as well as software developers, magazine editors and book publishers. This will be the largest presentation of hardware and software ever assembled in the Northeast.

You will be enthralled, entertained, and educated. You'll be able to see computer generated art, graphics and animation. You'll listen to computer synthesized music, watch computerized amusements, play electronic and video games, and attend dozens of free tech talks given by internationally recognized speakers. Don't miss the Northeast's largest gathering of computers and computerists.

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This will be your one opportunity to see all of the small and medium-sized business systems under one roof. Attendance at the show is a must for those contemplating the purchase of new machines. Every major name of computers, data and word processing equipment, peripherals, and software will be represented at the show.

You will see the latest in office automation, business software, and information systems. You will hear clear non-intimidating and non-technical explanations of how businessmen and professionals like yourself are using tomorrow's technology—today—to increase productivity and profits, yet decrease their workload.

The show is also the place for people interested in starting their own computer business, changing jobs, or just enjoying the futuristic displays and exhibits such as THE OFFICE OF THE FUTURE—THE KOMPUTERIZED KITCHEN OF TOMORROW—THE $1,000,000 EXECUTIVE's MOBILE OFFICE.

So if you're a businessman • hobbyist • doctor • scientist • engineer • accountant • lawyer • researcher • programmer • technician • educator • student • or homeowner—don't miss the Northeast's largest and most exciting computer exposition, and don't forget to register at the door to win the free computer.

Produced by Northeast Expositions/P.O. Box 678/Brookline Village, MA 02147
617-522-4467

Ramblings, con't...

Exidy Incorporated

Exidy introduced a **Video/Disk** attachment for the Sorcerer. This peripheral contains a 12" video display and dual mini-floppy disk drives with data storage capacity of 630K words. The swivel based unit attaches directly to the Sorcerer computer's keyboard enclosure to form an attractive desktop computer system.

The video display utilizes a P31 phosphor for readability and a 20 MHZ bandwidth for clear pictures. This yields 240 x 512 graphics resolution.

Software included with the hardware consists of the popular CP/M operating system, Z80 Assembler, text Editor, linking Loader and Microsoft Disk Extended BASIC. Exidy Video/Disk is priced at $2,995.00 retail.

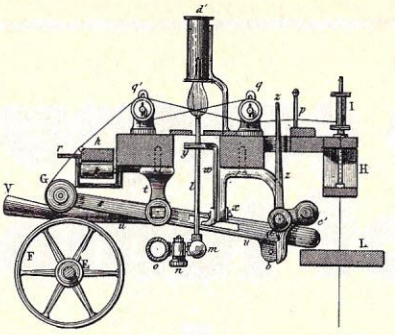
Exidy also introduced two **ROM PACs**, one for word processing which supports Diablo/Qume printers or modified Selectrics. The Development PAC has a Z-80 Assembler, line-oriented Editor, and Debugger. ROM PACs list for $99.00 each.

Exidy: Reader Service No. 253

Interact Electronics

Interact announced the **Model One Benchmark**, the "no-frills" version of its Model One Computer, retail price is $449.95.

The Model One Benchmark is one of four variations of Interact's Model One, which includes their top-of-the-line Professional-Plus, as well as the Professional and Standard. All four



Model One packages use the same 16K memory processor, but combine different attachments, accessories and program tapes.

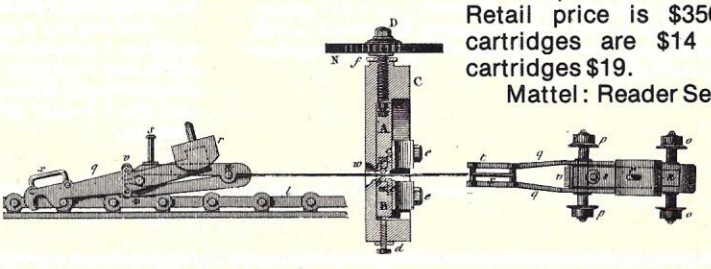
The **Model One Professional-Plus**, priced at $699.95, includes raised keyboard (previous Interact models did not have this) a peripheral (printer) interface, Level II Basic tape, and Program Pack I (a set of 12 program tapes), two entertainment controllers and one data tape.

Model One Professional, (599.95) is identical to the Professional-Plus, but does not include the peripheral interface. The **Model One Standard**, ($549.95) is similar to the Model One Professional but has a standard height rather than a raised keyboard.

The **Model One Benchmark** has a full-size keyboard, a built-in cassette deck, television connector cable and RF switchbox, as do all the other models. Because it is tailored for the first-time user, the Benchmark unit comes with an Edu-Basic Program tape rather than a Level II Program tape. Edu-Basic is a simplified, BASIC language which uses regular English to introduce the programming concept.

We were impressed with the extensive program library offered by Interact. There are six tapes in the Management Series, six in the Strategy Series, twelve in the Education and Entertainment Series and four in the Programming Language Series. Most tapes are modestly priced at $8.95. Ken Lochner, President of Interact, feels that "software is the pivotal point in the mass marketing of a personal computer." To which we say, "amen."

Interact: Reader Service No. 254



Mattel Electronics

Mattel Electronics introduced **Intellivision** at the Consumer Electronics Show. Will it take the world by storm? Will it be a viable competitor for Atari or Texas Instruments? If the booth personnel were any indication it doesn't stand a chance. When I asked for more information on it, I was directed to pick up a press kit in the press room. I responded that there were no press kits, and couldn't someone at the booth answer some of my questions. No I was directed to another person who said that they really didn't know anything about it but it played some nice games. There's no doubt that the graphics on the games are about as nice as we've seen anywhere, rivaling Atari, Texas Instruments and APF. On the other hand, their attitude toward the press was curious to say the least.

Anyway, through sheer persistance we found that Intellivision is based on the new 16-bit General Instrument chip set. Like the APF, the basic unit is a game playing video computer to which can be added a larger unit containing a 60-key keyboard and tape cassette mechanism for simultaneous digital/audio input/output.

The usual game paddles or joysticks are replaced by unique controllers with a 12-key pad (like a Touch Tone phone), four buttons on the side and a large direction-sensitive touch disc at the bottom. This is clearly the most sophisticated game controller we've seen.

The game cartridges (plug in ROM's) employed outstanding graphics and sound effects. While we didn't see the computer in operation, if it is up to the game unit as we would expect, it will be a strong contender, booth personnel notwithstanding. Retail price is $350; most game cartridges are $14 and education cartridges $19.

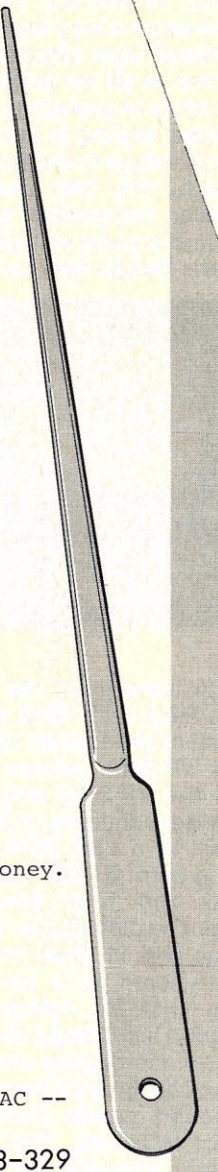
Mattel: Reader Service No. 255

An Open Letter to Anyone Selling or Building a System Around a SOL, Apple or TRS-80 Computer

Computer Systems Division

Exidy is moving to greatly expanded production facilities. Right now is the time for you to move up to an improved computer system: one built around our Sorcerer computer rather than a SOL, Apple or TRS-80.

The new 48,000 square foot plant (more than double our present size) has the capability of building and testing 200 computers per shift. With more than a year of production under our belts, we are shipping a reliable, well-debugged product.



Compare the Sorcerer to the others:

SORCERER vs SOL

The Sorcerer easily replaces the SOL and provides many extra features for about 40% less money. Sorcerer reads cassette tapes in CUTS format. Most SOL software runs on the Sorcerer with little or no change. And Sorcerer comes with the same I/O ports as SOL. For many extra benefits, read on.

SORCERER vs APPLE

You can ask the Sorcerer to "come out and play." But otherwise it's all business. Standard with Sorcerer are: Floating point BASIC, lower case characters, serial and parallel I/O ports, a numeric key pad, two cassette interfaces with motor control, plus all the features described below.

SORCERER vs TRS-80

On the surface, the TRS-80 may cost less, but compare the capabilities -- Sorcerer is the bargain. With Sorcerer's plug-in ROM PAC software, you're not locked into BASIC. You can even create turn-key application packages that come up running.

SORCERER vs EVERYBODY

Our video display is the winner. Full 128 ASCII character set (including upper and lower case); 30 x 64 screen display (1920 characters on screen); 64 pre-defined graphics characters; 128 user-definable characters; 512 x 240 point resolution. Sorcerer easily expands to a disk system that runs CP/M software; add S-100 bus products with our expansion interface.

All in all, Sorcerer will give your system more value for less money. For more proof, just drop us a note describing your needs.

Sincerely,

Exidy, Inc.

Exidy Incorporated
Computer Systems Division

P.S. This letter was prepared with our new Word Processor ROM PAC -- available now at $99.00 suggested retail price.

390 Java Drive, Sunnyvale, California 94086 (408) 734-9410 Telex 348-329

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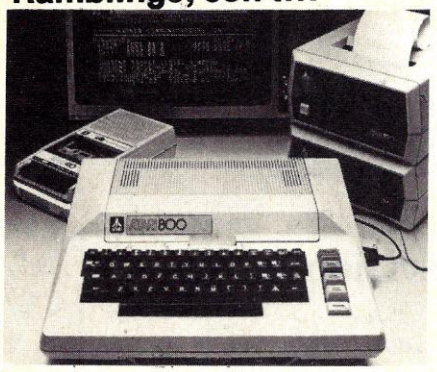
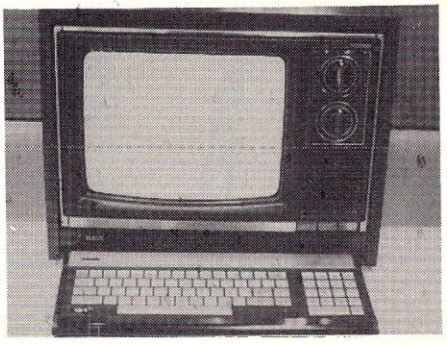
Ramblings, con't...



Atari

Atari continued to show the **Atari 400** ($550) and **Atari 800** ($1000) on which we've previously reported (April 1979, pp. 16 and 62). However, they did announce a very extensive line of **educational tape cassette programs**, seventeen in all on subjects ranging from history to sociology, accounting to physics, writing to auto mechanics and psychology to economics. Retail $40 each. We find these releases especially impressive given Atari's heritage as a game company.

Atari: Reader Service No. **256**



RCA

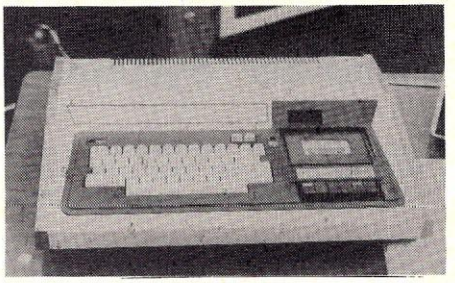
RCA introduced the **VIP II** based on the RCA CDP 1802 microprocessor, one of the fastest mpu's around. Model VP-2001 comes with 4K of RAM; the VP-2002 comes with 8K. Both are expandable to 32K. BASIC is resident in a 12K ROM. It is a full floating point BASIC with ten special display and tone generator commands. The display has 16 characters per line and 11 lines on the screen. The keyboard is a completely flat design with 74 contact keys (not proximity) including a 16-key hex pad.

The video display permits the use of four background colors and eight foreground colors (within each of 1024 color zones). The built-in tone generator provides 256 tones over a four-octave range. The computer includes an audio amplifier and speaker.

Three languages are available. BASIC which we all know and love; CHIP 8, and graphics-oriented hexidecimal interpretive language; and CDP 1802 machine language.

The entire unit is extremely compact measuring just 16½" wide x 7" deep x 2" high.

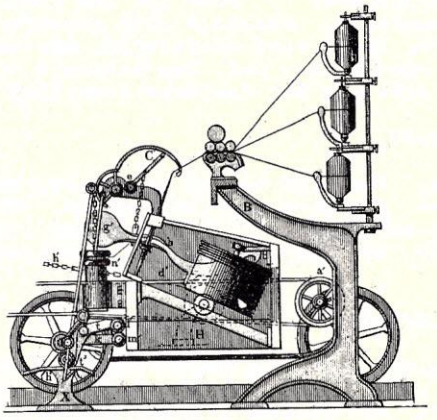
RCA: Reader Service No. **257**



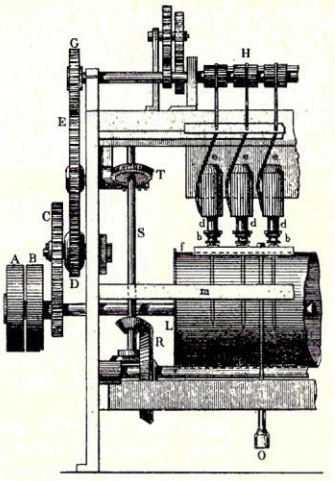
EACA International

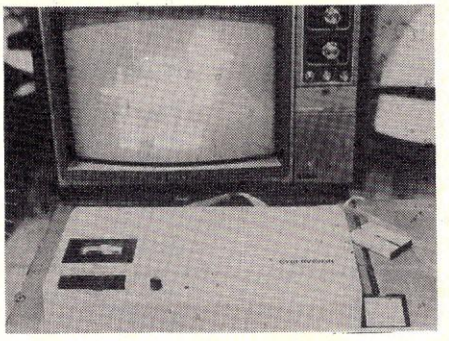
A new Hong Kong entry, the Video Genie EG-3003, is said to be the first system from Hong Kong of completely original design. It has Basic in 12K of ROM, 16K of RAM expandable to 32K, an S-100 bus interface, full keyboard, built-in cassette recorder in a handsome wood/plastic/metal housing. Price will be under $600.

EACA: Reader Service No. **258**



Kraco CB had their trained parrot act at the Consumer Electronics Show. Visitors were given cute little stick-on mini parrots who rode on shoulders.





CyberVision

The CyberVision system made by Broadrein Instruments has an impressive collection of interactive children's stories available for it. The original CyberVision 2001 was only available through Montgomery Wards but we are promised that the new models will be available through other outlets as well.

CyberVision: Reader Service No. **259**

Commodore

Commodore was showing single and dual floppy disk drives, several line printers, and a new speech synthesizer.

We'll report on the various other consumer electronics products of interest in the next few issues; it's more than will fit in just one column. □

Expand your TRS-80. Save $100.

Meet the Vista V80 Mini Disk System. The perfect way to upgrade your TRS-80* system. Inexpensively. (Our $395.00 price is about $100.00 less than the manufacturer's equivalent.) Here's how it can help you.

23% more storage capacity. Useable storage is increased from 55,000 to 65,000 bytes on drive one.

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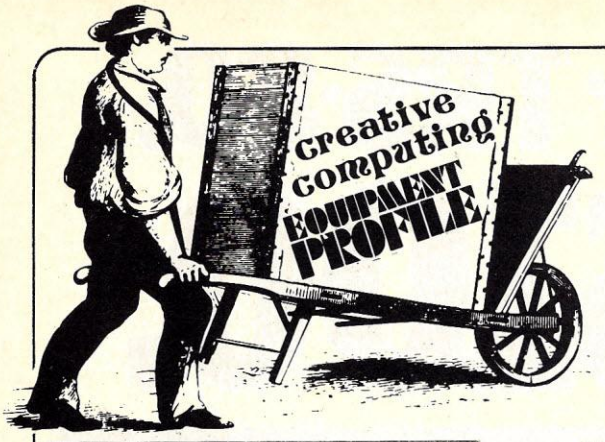


Texas Instruments 99/4 Home Computer

David H. Ahl

The following Creative Computing Equipment Profile was not based on our usual hands-on evaluation. It was based on seeing and briefly using the system at the Consumer Electronics Show and from published literature. We will have a complete evaluation as soon as we can get a system for testing.

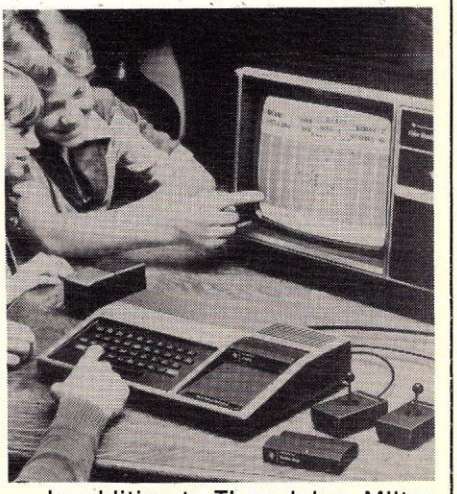
Texas Instruments' home computer, the TI-99/4 consists of a console with a TMS 9900 16-bit microprocessor, keyboard, 16K random-access memory (RAM), a 26K read-only memory (ROM) containing the operating system, extended BASIC, floating point, sound and color graphics software. The system comes complete with a 13-inch color video monitor. Internal RAM is not expandable beyond 16K, however, all is available as program area. In our brief encounter, we did not particularly like the keyboard. While the key layout is standard, the keys were smaller than a standard electric typewriter or terminal. One has the impression the whole keyboard is undersized although it actually is not. On the other hand, the entire console weighs in at just under 5 pounds. Suggested retail price for the 99/4 system is $1,150.00.

Resolution of the display is 192 x 256 pixels with 16 colors. The display format is 24 lines of 32 characters (8x8 dot matrix) with 256 programmable characters.

The sound synthesizer allows for playing three simultaneous notes (for music) and one noise tone (for sound effects). The user can control duration (1 to 4275 milliseconds), volume (on a range of 0 to 30), and frequency (110 Hz to 40k Hz).

Rather than floppy discs or tape cassettes the TI-99/4 uses a library of "command modules," each containing up to 30k of additional ROM. Titles available either at the computer's introduction or by year's end include: Demonstration, Diagnostic, Early Learning Fun, Beginning Grammar, Number Magic, Video Graphs, Home Financial Decisions, Household Budget Management, Video Chess, Football, Physical Fitness, Speech Construction, Investment Analysis, Personal Record Keeping, Statistics, Early Reading, and Tax and Investment Record Keeping.

The modules we saw appeared to be well planned and executed. For example, "Video Chess" was developed with the assistance of International Master David Levy. It allows you to play chess with the computer or with a friend. A special replay feature lets you watch an entire game over again. You can set up special chess problems for study purposes, and even sit back and watch the computer play both sides of the game. "Video Chess" can be a capable, ever-ready opponent or a friendly, patient instructor. The computer has three skill levels, and you can also choose the computer's playing style—normal, aggressive, passive or losing (if you need an ego boost).



In addition to TI modules, Milton Bradley is marketing four game modules for the 99/4: Yahtzee, Hangman, Connect Four and a neat, strategic pinball game, ZeroZap. Most have one- and two-player variations and varying skill levels. TI and M-B modules carry suggested retail prices of $19.95 to $69.95.

Home Computer, con't...

The 99/4 has a built-in calculator directly accessible from the keyboard. When the system is turned on, it "asks" which of three modes is desired: calculator, programmable, or command module.

TI BASIC is a full floating-point, 13-digit expanded BASIC that is fully compatible with ASCII and ANSI minimal BASIC. TI BASIC includes 24 BASIC statements, 14 commands, color graphics (16 colors), and sound and music over five full octaves. Unfortunately TI BASIC is not compatible with Microsoft. A Beginner's BASIC Guide by Bob Albrecht for self-teaching comes with the TI-99/4. For users knowledgeable about programming, McGraw-Hill has published a new book, **Programming BASIC with the TI Home Computer**, by Herbert Peckham. The book promises a tutorial approach to using color graphics, sound, and other more advanced features of the system. (Herb should be well-known to Creative Computing readers as the creator of some excellent educational software and booklets for HP 2000 computers).

Remote controls are offered as accessories to the TI-99/4. Two of these controls may be connected to the computer at the same time. Each includes a multi-position (360 degrees) joystick with a side-mounted "fire" button.

Among peripheral accessories offered is a Solid State Speech synthesizer with a suggested retail price of $150. By building a basic vocabulary into the language system, programmers can place verbal messages in their programs. The speech-synthesizer module has a 200-word vocabulary and plugs into the console. Future command modules will call up "spoken" words automatically.

Other accessories promised by TI in the near future include: a printer, a disk memory, and an RS-232 interface device for connecting the computer to other devices.

For people expecting bubble memories or some other revolutionary technological breakthrough or a dramatic drop in price, the 99/4 will be a disappointment. On the othe hand, the unit is highly user-oriented, has excellent support (self-teaching manuals, modules from M-B as well as TI) and will have a very strong dealer support program. As a result we expect it to have good consumer acceptance and substantially enlarge the overall market rather than taking sales away from other brands. □

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DR. MEMORY™(32k) Disk Word Processor **$49.95** includes UPPER and lower case plus complete printer controls. Variable page size, left and right margins, automatic paragraphing and more. On diskette with documentation.

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U-DRAW (16k) $17.95 - Hi resolution graphics editor.
ELECTRIC CRAYON (8k) $17.95 - Full color graphics editor.
MUSIC BOX (8k) $12.95 - three octave sound includes sharps, flats, note time, rests and tempo.
TANK WAR (16k) $12.95 - hi-res 2 player action.
MAZE GAME (16k) $12.95 - best 3-D color maze game.
SIDE SHOWS (8k) $12.95 - six colorful games in BASIC.
ESCAPE! (16k) $12.95 - a challenging 3-D adventure.
GLOBAL WAR (32k + APPLESOFT board) $17.95 - adult strategy game.
UNCLE SAM'S JIGSAW (32k + APPLESOFT board) $12.95 - educational United States geography game.

Available from dealers or write today to the
MUSE CO., 7112 Darlington Drive, Baltimore, MD 21234
Order by phone (301) 661-8531 MASTERCHARGE and VISA welcome

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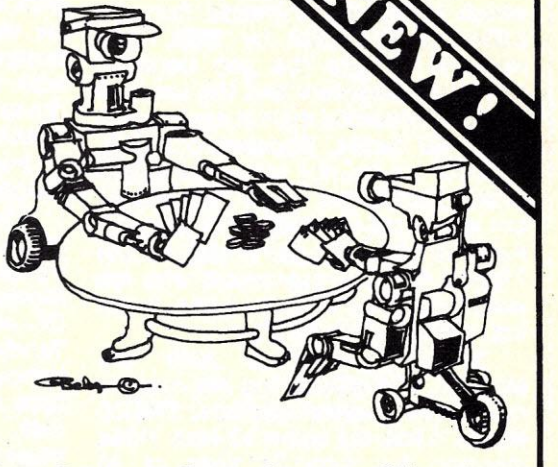
More Basic Computer Games

NEW!



Our fabulous new book, **More Basic Computer Games**, brings you 84 brand new games in Basic, ready to run on your computer. Some have been published in Creative Computing magazine but most are completely new!

Includes space games like Close Encounters, Deepspace and ICBM. Or match wits with Lewis Carroll, evade a man-eating rabbit, become a millionaire, race your Ferrari, play a tennis match, throw mud pies at a schmoo (who throws back), crack a safe, joust with the evil black knight, or trek across the desert on your camel.

More Basic Computer Games has complete listings and sample runs in large type, along with thorough descriptions of every game. Large format paperbound, 192 pages. $7.50 plus $1.00 shipping and handling in U.S. ($2.00 foreign). NJ residents add 5% sales tax. Send your order and payment to Creative Computing, P.O. Box 789-M, Morristown, NJ 07960. Visa, MasterCharge and American Express okay. For faster service, call in your bankcard order to:

800-631-8112

(In NJ, call 201-540-0445)

Radio Shack's New TRS-80 Model II: Bigger, Faster, and Aimed at Small Business

Stephen B. Gray

Radio Shack, manufacturer of the best-selling TRS-80 personal computer, introduced its big brother, the new TRS-80 Model II, at a New York City press conference in late May.

The new computer is said to perform as a general-purpose dataprocessing machine, an intelligent terminal, or a word processor. Software is available for general ledger, accounts receivable, inventory control, mailing list management and payroll.

The TRS-80 Model II microcomputer system, designed and manufactured by Radio Shack in Forth Worth, is not intended to replace or obsolete what is now called Model I, but, according to John V. Roach, Radio Shack executive vice-president, is "specifically designed to take up where the original TRS-80 leaves off—a machine with increased capacity and speed in every respect, targeted directly at the small-business application market. A market which has been estimated from $1 billion to $2 billion by 1983. This machine bridges the gap between personal computers and the low end of the commercial market such as the IBM 5100 series, Dapapoint, ADDS, etc. Yet we do not plan to emulate these companies' sales techniques but rather plan to market this equipment in much the same way as the TRS-80 to those customers who are willing to come to us for sales, training, and maintenance."

Software-compatible with the Model I, and resembling the smaller computer in several respects, TRS-80 Model II has the same 12-inch video monitor, but with 24 lines of 80 characters, with both upper and lowercase, as compared to 16 lines of 64 characters, uppercase only, in the Model I.

The TRS-80 Model II has a built-in 8-inch diskette drive at the right of the screen, providing half a million bytes of storage in addition to the 32k or 64k bytes of internal RAM. The drive is manufactured by Shugart, and second-sourced by two disk manufacturers whose names Radio Shack executives would not divulge.

Additional diskette drives are available in an expansion chassis that holds up to three drives, and which mounts in or on a system desk.

The new keyboard includes Control, Escape, Caps, Hold, Repeat and two software-programmable Special Function keys not found on the Model I keyboard.

Prices for the TRS-80 Model II start at $3450 for a 32k-byte computer with it's built-in diskette drive, $3899 for the 64k-byte machine. The disk expansion with one drive is $1150, with two drives $1750, with three drives $2350. The Model II system desk is $350. Deliveries are scheduled to begin July 1 in the U.S.A., and January 1, 1980 elsewhere.

The Model II uses the same Z80 processor as the original TRS-80, but operates it at twice the speed. A direct memory access feature, according to Dr. John D. Patterson, director of Tandy Systems Design, "further enhances throughput by controlling the data transfer between memory and disk, allowing the CPU to perform other tasks simultaneously."

Two new line printers were also announced for the Model II. The TRS-80 Line Printer II, a relabeled Centronics 730, is a 7 x 7 dot matrix machine that operates in both friction feed and pin feed modes, printing 50 characters a second on 8-inch lines of 80 characters, and priced at $999. The wide-carriage Line Printer III, made by Centronics to Radio Shack specifications, with a 9 x 7 dot matrix, printing bidirectionally at 120 cps on pin-feed paper up to 15 inches wide, is priced at $1999.

An enhanced Level-III version of the TRS-80's Level II Microsoft BASIC and TRSDOS operating system are automatically loaded in memory when the machine is turned on. In addition, each time the computer is turned on, it tests itself.

Built-in I/O capabilities include two RS-232C channels and one Centronics parallel port. Future expansion is provided for via four plug-in slots for optional PC boards.

As for software, Jon A. Shirley, vice-president of the Radio Shack Computer division, noted that "About the same time we start shipments we will have the first of five business packages. All of these will run on the basic one disk version of the Model II. There will be a General Ledger capable of handling 500 accounts and a Payroll system that will handle up to 500 employees in up to three different states. An Accounts Receivable package will offer a variable number of accounts versus number of transactions ranging from 300 accounts with up to 8,000 transactions per month, to 2,000 accounts with up to 1500 transactions per month.

Another new package is a very capable Retail Inventory system that handles 3000 items. Finally, we will offer a mailing list system that can handle up to 4000 names. Mailing list management has proved a popular item for churches, school, groups, as well as for business. Prices for these programs will range from about $150 to $400, keeping them in a low price range for software of this capacity.

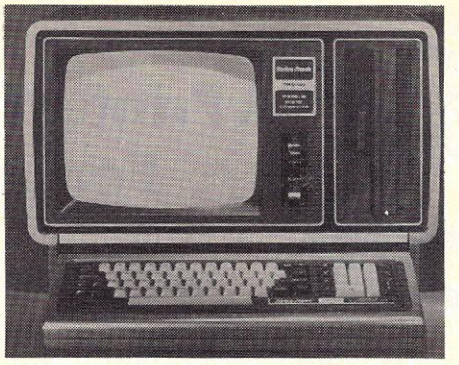
Beyond these first five will be many more to come. One of the first will be a comprehensive word processing software package which will turn the Model II into a versatile word processor just by adding a printer. Also to come will be applications packages for medical and legal offices, small businesses, specific industry groups and education. In addition, we will be offering more language capability and upgraded operating systems."

Also announced were several programs for the TRS-80 Model I,

including a Payroll program for up to 100 employees, a Retail Inventory Control system for up to 1000 items, Accounts Receivable, Advanced Statistical Analysis, and Real Estate packages 1, 2 and 3. The real estate packages, which will be eventually expanded to an eight volume set, sell for $30 each and, according to Shirley, "represent an excellent example of how an under-$1,000 computer can provide a small business with very sophisticated software dedicated to a specific industry. These packages range from simple calculations of mortgage payments to the present value of income streams and other very complete calculations for the real estate investor." Also coming is a $99 FORTRAN, and a stock analysis package developed in conjunction with Standard & Poors.

The Radio Shack TRS-80 Model II will be sold at Radio Shack Stores and Computer Centers, and participating Radio Shack dealers, nationwide.

Radio Shack "will fall slightly below our goal of 50 centers by June 30th," according to Charles A. Phillips, senior vice-president, operations. "As of today we have 38 open with the prospect of five more in June. The majority were opened in March and April 1979, and despite high, non-recurring opening costs, many have turned profitable and we are optimistic about their sales and profit contribution to the company for fiscal 1980."



Radio Shack's TRS-80 Model II has a built-in 8-inch diskette drive, 12-inch monitor displaying 24 lines of 80 normal or 40 expanded characters, and a keyboard with 76 keys including functions such as Control, Escape, Caps, Hold, Repeat, and two software-programmable Special Function keys, plus a "calculator" keypad. From one to three additional diskette drives fit into an expansion chassis, mounted on or in a Model II System Desk. Price for the system shown, with 64k bytes of internal RAM memory: $6,599.

The Radio Shack Model II, with a basic price of $3450, falls in between the Model I, with a basic price of $599, and the Tandy 10, a relabeled ADDS System 70, with a minimum price of $8995.

In comparing the Model II with other computers, Roach asked, "How does the Model II compare to other small business computers? An IBM 5110 in comparable configuration would cost the end user between $15,000 and $20,000. Hewlett-Packard 9800 System 45 desk-top computer with printer sells for around $20,000. The Wang WCS-15 is over $10,000 without printer. The new Datapoint 1400 is around $6,000 without printer and is almost identical to the $3450 Model II configuration.

The TRS-80 Model II is a multiple-function machine. It can, on a small scale, be a general purpose data processing machine doing the traditional general ledger, payroll and accounts receivable type of applications. It can also serve as a low-cost word processing machine with a variety of print qualities available depending on the printer you place in the system. Additionally it's a terminal device with a standard communications interface that permits you to hook up to a telephone through a low-cost modem. Therefore, in one package you have an affordable intelligent terminal word processing computer system. The acronym guys can have fun with that." □

ATTENTION TRS-80'S

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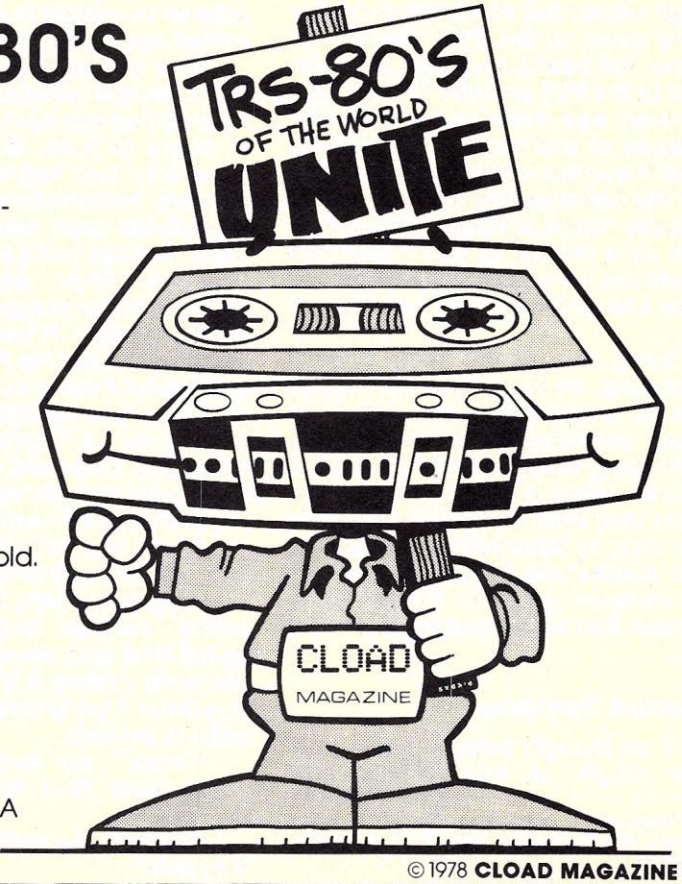

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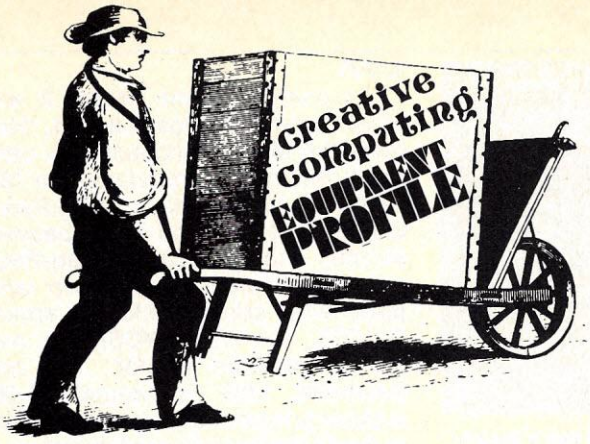
CIRCLE 113 ON READER SERVICE CARD



A Printer For Your PET — For Under $300!

Sol Friedman

Sounds fantastic but it's true! A good, reliable, quiet, small, lightweight, working printer for your PET computer, for less than $300! Not only that, it requires NO installation or special software. You plug the printer into the adapter, plug the adapter into the PET, type "OPEN 5,5: CMD 5: LIST", and it will print out a list without working up an electronic sweat.

How I came upon this beauty, and why, is a saga of frustration, in itself. I had agonized over which computer to buy for months. Our business is designing new games, and we had recently decided to work in the electronic games field, and it seemed natural that a small microcomputer would be perfect for working on new ideas, developing and testing them for play value, and polishing the rough edges. But which one to buy? It came down to the PET, TRS-80, or Apple. We finally narrowed our decision to the PET and the TRS-80. The decision was made to buy the PET because of two factors. The TRS-80 Level-II was not immediately available and the dealer selling the PET offered a 30 day return privilege. That would give us a chance to see if the PET would suit our needs. The PET proved to be everything we had heard about it.

Being new at the game of programming, we found that the hardest part of programming was trying to debug programs hundreds of statements long while looking at 25 lines at a time! Many a "happy" hour was spent long after midnight looking for that stray variable being initialized at zero somewhere in the labyrinth of our complex program. It was rightly decided that we needed a printer, and fast.

Selecting The Printer

If we thought buying a computer was rough, it was child's play compared with the attempt to select and get a printer! When you need a piece of equipment for a business, it really doesn't pay to fool around too much, so we decided that because the PET computer was so good, the natural selection for a printer should be the Commodore printer. We ordered the printer in June of 1978 and waited, and waited and waited....

Photo 1. The PET and the PR-40 (shown in center of photo)... a natural match-up!

After six months of waiting and promises still unfulfilled, we gave up. This waiting was costing us hundreds of hours of time. But our troubles were only just beginning. None of us were technically-minded enough to evaluate baud rates, serial interfaces, parallel ports and other specifications. What we needed was something that plugged into the PET, and away we go. Prices on that kind of equipment made the PET look like the accessory! Finally we found an ad by NCE for a "low cost PET printer, ready to plug in;" a Teletype KSR-33, for only $395. Now that was our speed! We wanted something especially low-cost because we needed a printer that would do the PET graphics eventually, and this printer would help us in the meantime, until the Commodore printer became available. So we called NCE and asked about delivery (we were getting a little gun-shy by this time). They promised delivery in a week to ten days.

"Great," we said, "how about some paper rolls to go with your printer?"

"How about a **case** of paper rolls," they said?

"Well..er..fine," we replied.

Problem solved! And true to their word, exactly ten days later there was the shipment from NCE. As we eagerly opened the carton containing our long-sought printer, we found...a case of paper rolls. We called NCE.

"Printer's on the way," they said. And, we waited, and waited, and waited...

The smartest thing we have done so far in this microcomputer business is to subscribe to most of the computer publications, including the PET GAZETTE and the PET USER NOTES. It was in the PET USER NOTES that we discovered an off-hand comment about a low-cost reliable printer kit PR-40 sold by Southwest Technical Products and an interface made by Sigma Associates. With some trepidation we ordered the PR-40 from SWT and the interface from Sigma. Delivery was promised (again) in a week or ten days. This time the kit arrived as promised.

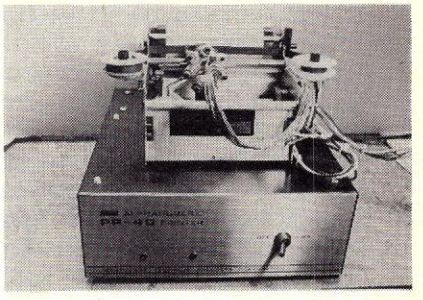


Photo 2. The SouthWest Technical Products PR-40 printer.

Building The Kit

The kit-building began. Although the instructions from SWTP are not as detailed as those from Heath, they are adequate. It might be somewhat of a challenge for a first time kit builder, but so would any kit of this complexity. There are two circuit boards, one a power supply with relatively few components, and the main board. Mounting and soldering the components is fairly simple and straightforward. The boards are roomy and well laid out. Important pitfalls to watch out for are:

Sol Friedman & Associates, Industrial & Toy Design, 480 Birchwood Way, Ft. Lauderdale, FL 33326.

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PET Printer con't...

- Bad solder connections-use a **minimum** of solder on this kind of work. Check the solder joints with a magnifying glass.
- Wrong placement of parts-it's easy to put in a wrong value resistor. You have to watch the color codes carefully.
- Wrong wiring-check carefully where you connect the wires.

Some minor problems were encountered in the values of a couple of the capacitors and the polarity of one electrolytic, but a call to SWTP customer service quickly straightened these out.

Everything you see above the chassis (printing head, paper feed, motor drive) comes fully assembled. It is simply a matter of mounting the assembly on the chassis and wiring a few wires to the motor and a switch. The circuit boards are mounted inside the chassis along with a power transformer, and a simple on/off switch. The printer could use an indicator light to show that it is on. There is a tendency to leave it on inadvertantly because there is no visible reminder that it is on. That is a small complaint and a pilot light could be easily rigged.

The Interface

Due to a misunderstanding the printer was completed and ready to go but the interface had not arrived. That was frustrating! But sigma was new and just getting into production so some small delays had to be expected. Even so, within a few days, we received the interface in good order. The plug for the PET IEEE 488 bus was included and SWTP instructions helped to make it easy to wire. The interface is not a kit, it comes complete and ready to use.

First Tests

At last, printer and PET were turned on. Suddenly, we had a runaway, mad printer on our hands! It ran, and ran, and ran, smoothly, silently, printing nothing. Paper was coming out of the printer at an alarming rate. We shut off the printer and began checking, and rechecking. Finally we called SWTP and yelled HELP! Graciously they spent time with us on the phone exploring the possibilities. Finally they asked if the microswitch was attached properly. I said that the microswitch was in the back and could not be at fault because it only checks to see if you have run out of paper. They replied that the microswitch was in **front** and controls the motor cycle, and there is no microswitch in the back. Sure enough, I found a microswitch in the front, operated by a cam run by the motor, just as they said. But it was news to them that there was one in the back also. Apparently they do not manufacture the printing head, and the last batch had an added microswitch to detect low paper on the roll. (We left this unconnected for now). Removing the wires from the rear microswitch and switching them (sorry) to the front microswitch was quickly accomplished. (Watch out for this when building your kit!) Again the computer and printer were turned on.... and nothing happened. Never have you seen such a celebration because **nothing** happened!

```
?%

 10 REM * FRIEDMAN ARTICLE/PET PRINTER/
 100 OPEN 5,5:CMD 5:LIST
 120 PRINT"THIS IS A HARD-COPY LIST MADE
 BY AN SWTPC PR-40 PRINTER AND A ";
 130 PRINT"SIGMA ASSOCIATES INTERFACE IN
TERFACE WITH A PET COMPUTER."
 140 "FOLLOWING IS A PROGRAM TO PRINT AL
L OF THE PET'S KEYBOARD "
 150 PRINT"CHARACTERS. NOTE THAT IT DOES
 NOT PRINT THE SPECIAL GRAPHICS ";
 160 PRINT" OR THE CURSER COMMANDS"
 170 PRINT
 180 PRINT
 190 REM *PROGRAM FOLLOWS: TYPE/RUN 200/
 200 OPEN 5,5:CMD 5
 205 PRINT"PRINT PR-40 CHARACTER SET"
 210 FOR I=0 TO 255
 220 PRINT CHR$(I);
 230 NEXT I
 240 PRINT
 250 CLOSE 5,5
READY.
?%
PRINT PR-40 CHARACTER SET

 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]↑ @ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]↑
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]↑ @ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]↑

READY.
```

Figure 1. A Sample printout from PR-40.

Then we typed 10 PRINT "NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THEIR PARTY" and hit return. Then we typed OPEN 5,5:CMD5:LIST and the printer came forth with 10 PRINT "NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THEIR PARTY". That is the saga of the SWTP PR-40 Printer and the Sigma Associates PI-1 Interface. Neither has given us one moment of trouble since.

Documentation & Specifications

In this age of poor documentation, a word needs to be said for the documentation included with the SWTP printer and the Sigma interface. In both cases the documentation is superb. We could find no fault with it. The same must be said for telephone calls for information to both. They were very cooperative, helpful and effective. The description of the printer follows, taken from the SWTP instruction book:

"The SWTP PR-40 Printer kit is a 5 x 7 dot matrix impact printer similar in operation to the well-known Centronics printers. It prints the 64 characters upper case ASCII set with 40 characters/line at a rate of 75 lines/minute on standard 3-7/8" wide rolls of adding machine paper. One complete line is printed at a time from an internal forty character line buffer memory. Printing takes place either on receipt of a carriage return or automatically whenever the line buffer memory is filled.

The printer can accept character data as fast as one character per microsecond or as slow as you wish to send it. The printer's seven parallel data lines are TTL compatible and may be enabled by a single 'data ready' control line or by separate 'data ready' handshake control lines. This universal approach makes the printer compatible with all computer and terminal systems having an eight bit parallel interface; including, of course, the MITS 8800 and SWTPC 6800 computer systems just to mention a few."

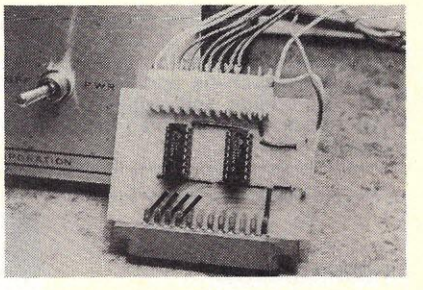

Photo 3. Sigma Associates Interface.

Included with the kit are clear, step by step wiring and assembly instructions, check out and adjustment directions, a technical description of the operation of the mechanical print mechanism and electronic circuitry, limited check-out instructions in case of difficulty, and an offer to troubleshoot the unit for you if you return it with a payment of $30 labor plus parts. There are detailed illustrations of the circuit boards and parts layout, color code chart for resistor values, parts list and pictorial of parts, and an exceptionally clear wiring pictorial for wiring the plugs and point to point wiring, plus a schematic of the unit. This kind of documentation is a great boon to amateurs like us.

Documentation for the Sigma interface includes excerpts from the

SWTP Instruction Manual, and an actual printout using the interface sent to you. Also, full instructions, description and drawings.

Limitations

This setup does have its limitations. It is great to use adding machine paper in the printer; it's inexpensive and readily available. If your major requirement is to obtain hard copies of your program listings, it does a beautiful job. If you want it to type letters, you need correspondents who don't mind 4-inch wide letters. The printer cannot reproduce the PET graphic characters, so if the special graphics are important to you, the PR-40 may not be for you. It will simply print the lower case characters instead. In place of the editing commands it prints "". As mentioned earlier, we have not had any down time with the printer. What it does, it does very well indeed.

Controlling The Printer

If you have the booklet "PET COMMUNICATIONS WITH THE OUTSIDE WORLD" by Commodore, then you have what you need to control the printer. If not, following is basic information and some examples.

TYPE	TO GET A PRINTED LIST
	to open line to the printer
	to get a list of your program on the printer
OPEN 5,5	
CMD 5:LIST	to close the line to the printer
CLR	
or	
CLOSE 5,5	recommended by Commodore, but does not always work.

USING PRINTER STATEMENTS IN A PROGRAM (PRINTS ON SCREEN & PRINTER)

```
TYPE
10 A$ =
"MESSAGE.."
20 PRINT A$      saves repetition, to print
30 OPEN 5,5        on screen and printer
40 PRINT #5,     prints on the screen (A$)
A$               opens printer
50 CLR           prints on the printer (A$)
```

TYPE (TO PRINT ON PRINTER ONLY)

```
10 OPEN 5,5
20 PRINT #5, "MESSAGE.."
30 CLR
```

Every once in a while, the cursor gets ornery and refuses to go to the next line when you hit return. When this happens, hit return, and if nothing happens, clear the screen. When you LIST, you will find that the PET has accepted the program line. If not in a program statement, type CLR and control will come back to the keyboard. We don't know why this happens, but suspect it's a problem with the PET.

To check if the printer is open, type CMD 5. If it is open, the printer will print READY. If closed, you will get "?FILE NOT OPEN ERROR" on the screen.

We have used the printer extensively in making hard copies of valuable programs, and for debugging programs. In designing our newest electronic game for Coleco Industries, called ZODIAC(TM), it was necessary to convert thousands of numbers to a hex code. A simple program did the conversion, showed the entered number and converted number both on the screen and on the printer tape. Long lists of these numbers were then used to enter them on final forms. With the hard copy lists, it was possible to have many people transcribing at once, thus speeding up the work considerably. □

SWTPC (Southwest Technical Products Corp.) address is: 219 W. Rhapsody, San Antonio, Texas 78216. The Printer order number is PR-40 ALPHANUMERIC PRINTER. Price was $250.

Sigma Associates is located at Box 2065, Princeton, N.J. 08540. Order number PI-1 SIGMA INTERFACE FOR PET & SWTPC PR-40 PRINTER. Price: $39.95.

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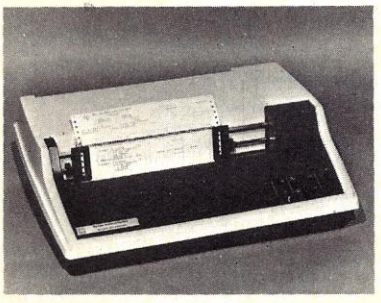

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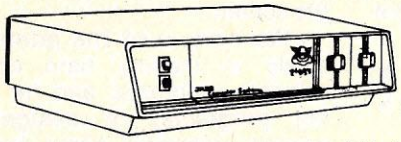

This sleak new mainframe is neatly trimmed to hold six S-100 boards. two mini-floppy drives. and is available in five colors. Power requirements: 115/220 VAC. 50/60 HZ. Weight: 27 lbs. (with drives). Dimensions: 21.375" Wide X 8.4" High X 15.875" Deep. Power Supply: 8 volts at 18 Amps unregulated. · 16 volts at 3 amps uregulated. - 16 volts at 3 amps unregulated. · 5 volts at 3 amps regulated. · 12 volts at 3 amps regulated.

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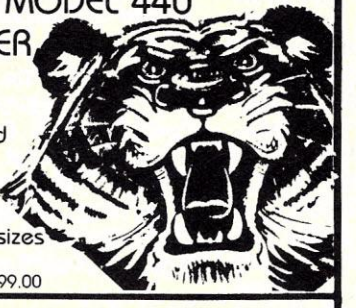

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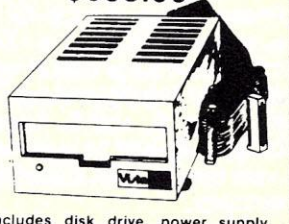

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CIRCLE 143 ON READER SERVICE CARD

Imsai's VIO Board

80 Characters Per Line & Graphics, Too!

Rod Hallen

Growing up with personal computers is a lot like growing up with any other hobby. When you first get into it, you don't know a whole lot about the hardware available and what would be the best for you. Also, computer hardware is being improved so rapidly that soon after you do make a decision something new has come along to change the rules.

I recently decided to move up to a mainframe computer with the following specifications: S-100, Microsoft BASIC, and CP/M which narrowed the choice a little. After more investigation and head scratching, I settled on the Cromemco Z-2. I chose the Z-2 for its hefty power supply, quiet bus, and reputation as the "Cadillac" of the micros. I also liked the fact that it utilized the Z-80 microprocessor.

The next choice that I faced was between an RS-232 video terminal and a memory mapped video interface board. This was an easy choice to make. My SOL had taught me the benefits of memory mapped video and I decided to stay with that type of system. Besides, I already have a good 15-inch video monitor and keyboard, making the video board route the cheaper option by far.

The most difficult choice was deciding which video interface board to buy. It had to be S-100 compatible to match my new Z-2 mainframe, have a 24 x 80 screen format, and have some kind of graphics capability. My final decision revolved around five different boards. I didn't have an opportunity to try any of them out before buying and my decision was based strictly on the literature that each manufacturer provided. I decided on the IMSAI VIO-C video interface.

The assembled VIO shown in Photo 1 is designed for S-100 computers which use a Z-80 or 8080 microprocessor and it comes in four different configurations identified as Basic, A, B, and C. These variations have to do with screen format, a firmware option, and the amount of video memory.

Over the past twenty years I have built dozens, if not hundreds of kits and homebrew electronics projects. Lately, however, I find that I favor software construction over hardware building and as long as the assembled version of a product doesn't cost more than $50 above the kit version, I buy the assembled board. The price spread in the VIO case is $185 and so I bought mine in kit form.

Rod Hallen, P.O. Box 73, Tombstone, AZ 85638.

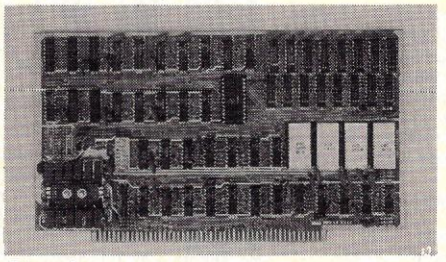

Photo 1.
The IMSAI VIO-C S-100 Video Interface Board. The four ROMS shown on the right side and the one in the center contain the firmware monitor, video drivers and character sets.

Assembly

After putting together as many kits as I have, I tend to skim the instructions and proceed with construction at a rapid pace. I won't spend a lot of time describing the actual construction. The manual that comes with the VIO is well written and even the novice kit builder should be able to assemble it successfully in a couple of evenings.

However, a strong word of WARNING is in order! READ THIS PARAGRAPH TWICE!! The VIO kit does not come with IC sockets except for the ROMs and I consider it foolish, if not foolhardy, to build any solid state project without sockets. One session of trying to remove a defective IC should make a believer out of you. Besides, the easiest and surest method of solid state troubleshooting is IC substitution, which is easily done with sockets. IMSAI sells a socket kit for $25 but I bought enough of the same brand of sockets from a mail order company for less than $8.00.

Very little troubleshooting information is contained in the manual and, thankfully, little was necessary. The "Theory of Operation" chapter and the schematics are informative enough for hardware types to solve most problems. IMSAI also has a repair service if you need additional help.

Optional Configurations

Table 1 lists the Basic and the VIO-C of the board. Basic is uppercase only and therefore didn't fit my word processing requirements. Since I didn't intend to use the Monitor program in the ROM, the only benefit the C version offered was the screen driver routine. An example of a simple screen driver which you can load into RAM is shown in the manual but I decided that it was worth $50 to have the complete video driver in ROM. Besides, I might find a use for some of the Monitor subroutines as I go along.

Table 1

Version	Video Memory	Character Generator	Firmware	Screen Formats	Price
Basic	1K bytes RAM	128 char (upper-case)	No	80 x 12 40 x 12 40 x 24	Kit: $190 Assembled $335.
VIO-C	2K bytes RAM	256 char (ASCII, control & graphic)	No	80 x 12 80 x 24 40 x 12 40 x 24	Kit: $375 Assembled $465

Available from: IMSAI Manufacturing Corporation
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Table 1.
IMSAI VIO Video Interface board configurations.

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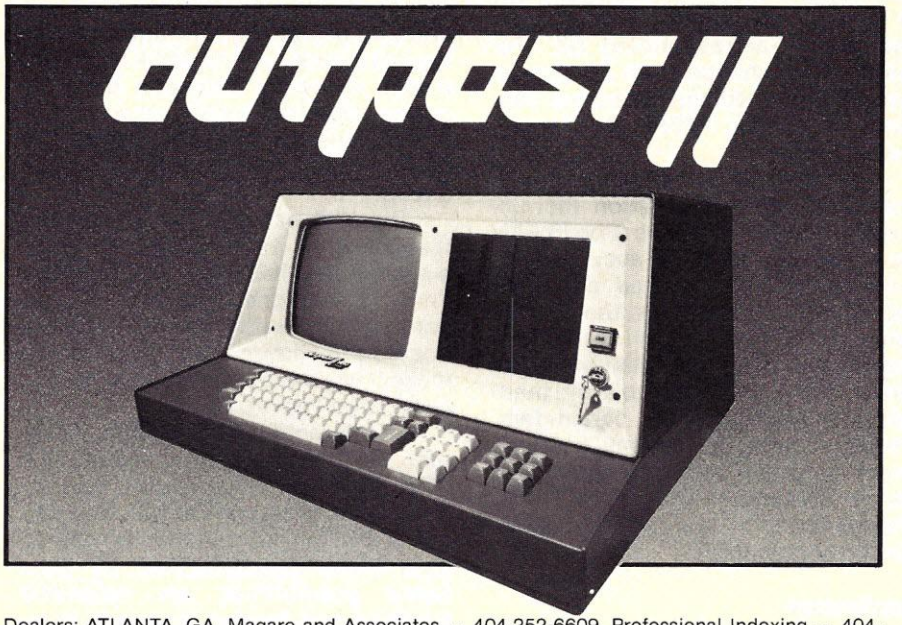

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CIRCLE 132 ON READER SERVICE CARD

VIO Board, con't...

Description

The video memory and firmware Monitor of the VIO occupy 4K and they must be addressed starting at F000H. The video memory runs from F000H to F7FFH and the Monitor occupies F800H to FFFFH. The addressing scheme used for the firmware makes it almost impossible to use unless your computer has a front panel. If the VIO is purchased without the firmware, the 2K video memory can be addressed anywhere.

The video driver and the Monitor are both contained in the same ROM but they are separate programs. Each time the computer is turned on a call to F800H must be executed. This initializes the video driver, clears the screen, puts the cursor in the upper lefthand corner, and selects the default screen features. These default features are: 24 x 80 format, uppercase only, and screen scroll mode.

Both Control Character Commands and Escape Sequences select a wide variety of options and features. These include cursor control, clear screen, tabbing, insert and delete lines, protect fields, graphics mode and many more. The manual explains how to implement all of the options and features of the VIO in both BASIC and assembly language.

Memory address F7FFH on the VIO board is the Memory Mapped Command Port Byte. The easiest way to change the screen format is to change the corresponding bit. For instance, to change from 80 characters per line to 40 characters per line, Bit 0 at location F7FFH is changed from a 0 to a 1.

This is especially easy to do with the Z-80's bit manipulation instructions but with an 8080 location F7FFH can be loaded into the accumulator, the desired bit, changed and then moved back or just store the desired value at F7FFH. Both techniques require that you know what the other bits are already in order to avoid inadvertantly chaning other parameters. I'm considering having my software check an input port connected to 8 sense switches. That way I can change screen format anytime I like at the flip of a switch!

Application

The Monitor routines allow for displaying and changing bytes or blocks of memory, search and compare, jump to location, cassette I/O and more. Monitor is at address F806H and an ASCII keyboard has to be connected to an I/O board addressed at port 2 with the Data Ready signal (strobe) at port 3 bit 1. The question that arises is, "How do you execute F806H to get into the Monitor if you don't have a front panel?"

Most computers will jump to a preselected address and start executing upon power-ON or RESET. The SOL always jumps to C000H, while the Z-2 allows the selection of any 4K boundary above 7FFFH (i.e., 8000H, 9000H, A000H, etc.). This is great if your monitor starts on a 4K boundary which the VIO doesn't.

Fortunately, I'm using the CP/M Disk Operating System and my CP/M Cold Start ROM resides at E000H on the ThinkerToys Disk Jockey Controller Board. With my Z-2 ZPU Jump-on-start address DIP switch at E000H, I'm all set, or at least almost. I still have to call F800H to initialize the screen or I can't see anything.

When the Cold Start Loader at E000H is called at power-ON, it loads the CP/M DOS from disc into memory and executes it but I first have to change the DOS to put characters to the VIO at F803H instead of to the SOL video address. Then I added a "CALL F800H" to the DOS and the VIO video is automatically initialized each time that CP/M is loaded.

CP/M has its own monitor system and I can use it to call the subroutines in the VIO ROM if I need any of them. Since most of them duplicate CP/M features, the only ones that might come in handy are the Cassette Load and Dump routines if I wanted to use tape as a back-up to the disk or to read a tape made by someone else. Of course, that tape would have to conform to the IMSAI tape format. The memory diagnostics might also be useful.

The VIO has a phantom feature that will allow its memory to reside in a system that has a full 64K of RAM. This is designed to operate in conjunction with IMSAI memory boards and I haven't found out how to make it work with my memory. In any case, I don't have 64K yet.

An interesting feature of the VIO is that the Character set is stored in a 2708 EPROM. This allows you to change the characters at will. You can use a PROM programmer or pay to have them reprogrammed for you. Some possibilities are scientific symbols and foreign language characters. Extensive information and programs are given in one of the Appendices for generating your own character set.

Another appendix describes how to interface the VIO to a standard television receiver. However, this is tricky when trying to display 80 character lines, as most such interfaces do not have the bandwidth required. It can also be dangerous if you try it on a transformerless TV set, a very common type. It is much better to get a good video monitor. Mine is a surplus studio monitor that sold for $75.

Graphics

One of the main reasons that I bought the VIO was for its graphics capability. It has a complete complement of graphic character from which to choose. 256 total ASCII and graphic characters are available and these are broken down into 96 ASCII characters, 32 control characters, and 128 graphics characters.

As you can see from Photo 2 a wide variety of characters are available. This is the complete 256 character set. In the ASCII or Extended text modes, Control characters are used to select various functions but in the Graphics text mode, Control characters (0 to 1FH) are displayed as shown by the first 32 symbols in the photo.

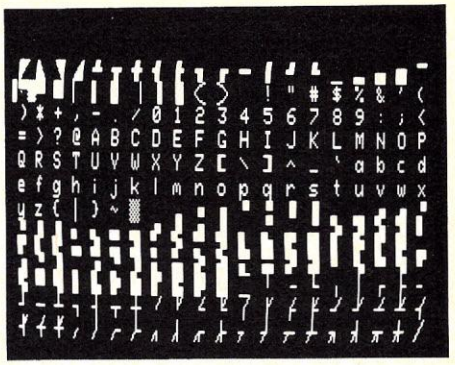

Photo 2.
This is the entire VIO 256 character set. The display uses the 12 by 40 format which means that all characters are shown double height and double width. The character above the numerals are the control characters and those below the lowercase are the graphics characters.

ASCII characters (20H to 7FH) are displayed in either the ASCII or Graphics modes and in addition reverse video is provided for individual characters in the ASCII text mode by adding 80H to the character code.

The graphics characters (80H to FFH) starting in the middle of Photo 2 and continuing to the bottom are available in the Extended Text mode in either positive or negative video and in the Graphics mode in positive video only. If all of this seems complicated, it isn't. You'll find it easy enough to understand after a little experimentation and it certainly is a good indication of the versatility of the system.

VIO Board, con't...

Since the VIO employs memory mapped video, each character position is directly accessible to the programmer at any time. Instead of feeding characters through the video port at F803H, you can write character codes to any memory location between F000H and F770H using the BASIC POKE statement or any of a number of assembly language instructions. The corresponding ASCII or graphic character will appear at the selected location.

The VIO manual contains large scale drawings (every dot is shown) of all 256 characters along with the appropriate code for each. Just about anything can be drawn using the right combinations. Each character position can be divided in half vertically and in thirds horizontally which gives you a 160 horizontal by 72 vertical plot resolution. This should be satisfactory for most graphics requirements.

All of the characters just described can be displayed in four different sizes as shown in Table 2 (which greatly increases your graphics options).

Table 2

Format	Character Size
24 x 80	Normal
12 x 80	Double height
24 x 40	Double width
12 x 40	Double height and double width

Table 2.
Choosing one of the four available screen formats will determine the size of the characters.

Conclusion

My only real complaint is directed to IMSAI's lack of response to my letters. I've written two, asking for information, and two months later have yet to receive a reply. In the manual they offer the VIO version of CP/M to registered CP/M owners for a copying charge but I had to write my own CBIOS (Custom Basic Input Output System) due to their lack of response. This seems to be a common problem in the microcomputer field. I keep copies of all letters sent out and find more than 30% go unanswered.

I am completely happy with the board. Considering the price and features provided, I think it is best suited to my needs. I like the memory mapped video, the large screen format, and the graphics capability. Now all I have to do is write the software that will cause my Malibu 160 line printer to print the same character set as the VIO. This should be possible since the Malibu character set is in RAM and it is easily changed.

I have been doing my word processing with the cassette version of Michael Shrayer's Electric Pencil for almost two years. He recently came out with a CP/M compatible version designed for the VIO. The combination of CP/M, VIO, and Electric Pencil II is outstanding. □

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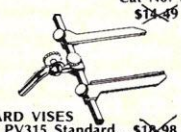
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1432	SSM-MT1	15 SLOT MOTHERBOARD, bareboard	$ 39
1411	SSM-IO4	2 PARALLEL + 2 SERIAL PORTS, kit	$139
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Computers and Dance

Linda Hirschmann

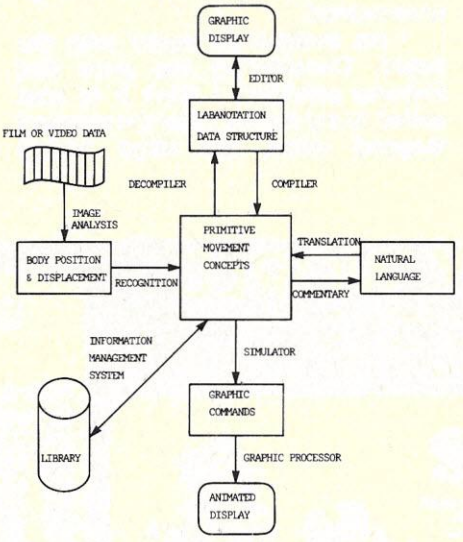
"The world of The Four Temperaments is wide and swarming with possibilities, yet if we could pass the choreography through a computer to see how many core gestures there actually are, there would probably not be more than six—maybe eight..."

Arlene Croce, The New Yorker, December 8, 1975, discussing Balanchine's 1946 ballet.

Bubble Man, a tall, mummy-like creature, stiffly raises one arm and lowers it, walks a bit, and bends forward from the chest. Stick Figure, a dapper toothpick with kite-shaped chest, head and pelvis and spindle legs, takes several steps, turns in a circle three times, somersaults, executes four pirouettes and slowly bows, three times. To the strains of "The Skater's Waltz," Sausage Woman, a pudgy ballerina made of rounded links, bends her knees in a deep plie and lifts off like a hot-air balloon. On landing, she pirouettes on point, arms in first position, and curtsies to the audience.

The three robot-like characters just described are not the latest in children's toys. Rather they are the creations of computer scientists who, in the past several years, have been programming computers to produce animations from dance notation symbols. The films, crude though they may be at present, are the results of turning graphic primitives of dance notation into more comprehensive symbol clusters and, finally, translating these through a graphic simulator into a display of human figures on a screen.

An animation of a dancer, according to Dr. Steven Smoliar of General Research Corporation and a chief collaborator in studies in this field at the University of Pennsylvania's Moore School of Electrical Engineering, is a more desirable tool for the choreographer and most dancers than various notation systems which few of them know. Labanotation, the most widely used of these, has been in existence since 1926. Formulated by choreographer/dancer Rudolf Laban in England and refined and expanded on since 1940 by the Dance Notation Bureau and followers around the world, its geometric symbols can calibrate with great precision the movements of the human body not only in dance, but in other activities as well.



Badler and Smoliar's system for notating, modeling, analyzing, and describing human movement.

Smoliar, along with Dr. Norman Badler, Joseph O'Rourke (co-inventors of Bubble Man), Wayne Tracton and Lynn Weber, all working in conjunction or independently at the Moore School, and T.W. Calvert and J. Chapman of Simon Fraser University in Burnaby, Canada, prefer Labanotation for two reasons: it's the only dance notation system with a standards organization backing it and it has the property that a piece of choreography can be reconstructed from it with great fidelity. Two other notation systems have loyal adherents as well. Benesh notation, taught at London's Institute of Choreology, is more frequently used to recreate ballet rather than modern dance styles and gives pictograms of the body at certain time intervals. D. Herbison-Evans, in his work at the University of Sydney, used Benesh to implement his Sausage Woman's solo. Yet a third system, devised by Noa Eshkol and A. Wachmann, attempts to catalogue all joint angles that occur in the body over a period of time.

Dance notation, though, has, as Smoliar puts it, "a low literacy rate." Until he and Maxine Brown, working at Penn with Muriel Topaz of the Dance Notation Bureau in the late 1960's, invented a graphics editor for Labanotation, the process of even notating a half-hour ballet was a prodigious undertaking. A notator used to sit in on the creation of a ballet from start to finish, taking copious penciled sheets of notation symbols which then had to be checked each day and at the end, recopied in ink. With the aid of a graphic display editing terminal, though, the notator could type symbols on to a screen containing the Labanotation vertical staves, store each page of the score, and retrieve a part or the whole as desired for reference or editing. Weeks of notation have thus been condensed into a few hours.

Learning a role is still done the old-fashioned way on a live-body-to-live-body basis through demonstrating the steps involved.

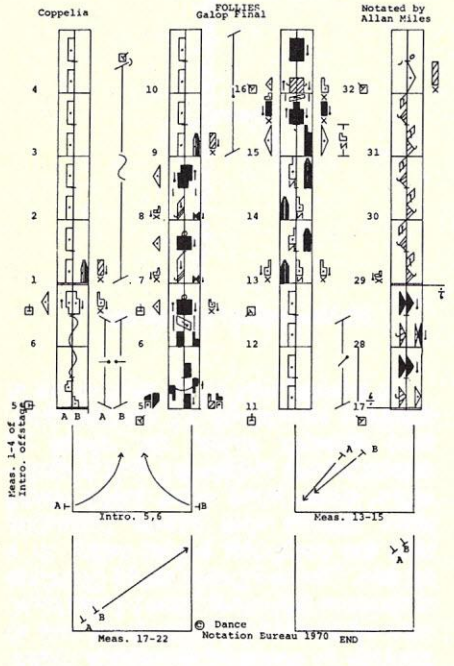
Yet the number of dances recorded in Labanotation remains small and the majority of dancers and choreographers have not familiarized themselves with the system. Learning a role is still done the old-fashioned way on a live-body-to-live-body basis through demonstrating the steps involved.

"None of the major dance companies around the world take dance notation seriously," explains Smoliar. "Dancers still feel the best way to learn a ballet is through viewing it over and over again. Choreographing a work is thus really a combination of

Linda Hirschmann, 430 E. 56th St., New York, NY 10022.

intuition and memory. What's needed is a reasonable way to preserve information as the dance is being created."

The computer's function is not simply to record what's there, but to record how one got there. The machine actually analyzes movement in data and control structures, starting with Labanotation or some other basic system, and adding clarifying modifiers. These modifiers, according to Tracton, must be part of the symbol; in other words, by modifying a symbol, you redefine symbols within Labanotation. Currently a computer editor will take Labanotation scores and compile them into movement primitives. Essentially, this means a lexical analysis of Labanotation to see what broad categories of movement can be derived to form a workable data structure. Once you have a better language which you can feed the computer, those new symbols can be used to produce body positions which eventually an animated figure can perform. As Calvert emphasizes, the computer is concerned with the analysis of movement, whereas a videotape or film of a dancer only yields a description of that movement.



Example of Labanotation score: an excerpt from Delibes' Coppelia.

It is this probing of the ways in which the human body moves which occupies the scientists in their quest for new linguistic concepts based on Labanotation and, ultimately, a higher-level language with which to issue commands to an animated figure. As Badler offers, "we want to answer the question 'what does the notation represent?' " Or, as Smoliar elaborates, "you can notate a dance, or film it, or, as we're attempting to do, specify a goal you wish to have happen, such as 'what must I do to pick up that ashtray?' We're trying to describe movements in terms of their results, not how they are achieved."

Calvert, who designed Stick Figure, and who is involved in the broader study of kineseology, says that "once you arrive at the topology of the body and have instructions for it, these are interpreted through Labanotation commands. The information is put together in a data base which tells you first, where you are, second, where you're going, and thirdly, how long it will take you to get there—that is, the instructions specify the co-ordinates in space which each body segment must achieve as time progresses."

His Stick Figure lacks back or front differentiation, but has most ambiguities resolved so that it is acceptable, he claims, to those dancers who've assisted him and seen his computer-driven movie. For the simple act of walking, which may vary from choreographer to choreographer, the system has "macro expansion," whereby Labanotation symbols with appropriate modifying signs stored as preprogrammed sets of instructions, can capture these stylistic nuances. So far, though, only crude macros exist so that, in the case of walking, a command would indicate the change of support from one foot to another but not the angles of the joints. It might say, in addition, how far to go or how many steps to take. And since Labanotation has built-in default positions, if the command given does not contain sufficient information for the figure, the figure makes assumptions. For example, it might decide to stop walking before another totally different movement commences.

High priority amongst researchers is being given to the development of a library of useful macros. As Smoliar explains, "it will generally entail more symbols for more subtlety. If the movement really **is** normative, you don't want to have to labor over lots of symbols to record or interpret it. Through the computer's capacity for macro expansion it will be possible to allow sparse combinations of symbols to serve as abbreviations for more complicated information."

Furthermore, as Calvert suggests, if parameters can be specified to alter the sequence of macro instructions in a simple way, the usefulness of the commands will be enhanced. For instance, parameters could be developed to tell which direction a dancer is facing or, in the case of walking, whether the steps should be stiff or springy. A macro command with parameters might then read: WALK VERY SLOWLY TO LEFT FRONT UNTIL (Edge of Stage). Such commands would, Calvert hopes, be valuable aids to notators, choreographers and animators, for the user of the machine could, after devising a batch of helpful macros, use them repeatedly in different ways within the same ballet or different scores.

However, while members of the dance community appreciate such efforts to facilitate communication about their ephemeral art, they do not believe that dance is best communicated linguistically. Therefore, above and beyond the higher-level language computer scientists are developing, they prize the visual representation based on the language's constructs. The choreographer would then have a graphic model he or she could teach dances to when no live bodies would be in the dance studio.

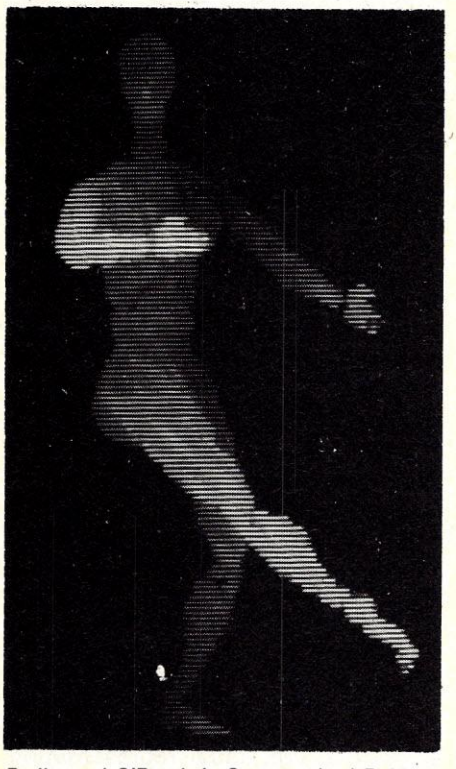
Of course from the scientists' point of view the key to an effective animation is resolving the question of how you communicate with the model, be it Bubble Man, Sausage Woman or some other prototype.

"The quality of the image is secondary," asserts Badler, "and even the act of making the image is comparatively easy because the

Dance, con't....

better we understand it, the more we can think of designing the necessary hardware."

Nevertheless, designing 'Everydancer' or the 'Six Million Dollar Ballerina' took considerable calculation, as Badler and O'Rourke's works shows. Envisioning the human body as a collection of joints and segments, they made Bubble Man as the union of overlapping spheres. With the dance community in mind, the model fit the criteria of being three-dimensional, displayed in real time, and capable of being viewed one segment at a time. Bubble Man has two other essential features besides: collision detection, so that illegal intersections of the body with itself or other objects are eliminated, and hidden surface removal whereby shading of spheres makes the closest ones light and the farthest ones darkest.



Badler and O'Rourke's Computerized Bubbleman helps dancers learn complicated dance routines.

Now Badler is working on the problem of contacts which Bubble Man makes with itself, the ground plane, other people or objects. "If we put a costume on the model," he points out, "it causes many difficulties since any attire would alter the skeletal character of the body." It will shortly be feasible, though, he explains, to show the figure with its shadow, having the shadow define contact with the floor.

For instance, parameters could be developed to tell which direction a dancer is facing or, in the case of walking, whether the steps should be stiff or springy.

Calvert's Stick Figure can be seen from different perspectives and in his film it is viewed from overhead, from a distance as far as the back rows of a theater might be, and up close. The computer performs certain spatial transformations so that while the display is in progress, the viewer can by turning a knob 'walk around' the stage.

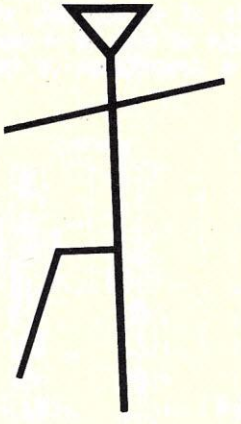
The inevitable question which arises is, instead of this computer system or the use of Labanotation, why not simply record ballets on videotape taken from several angles to give dancers and choreographers a permanent record? Smoliar has a quick reply: "As far as Labanotation is concerned, the computer can read it better than any film can and is able to zero in on details or suppress them to get a broader view. Ultimately, the computer will compose the first draft of a ballet score. And it is superior to videotape alone since it will be able to show a dance at different speeds, with varying levels of detail and from many points of view."

This would enable the choreographer to have a more direct part in the recording of a dance, correcting the animated display before the notator, who would, in turn, change the source code. At some point, the choreographer will also be able to tell the computer the corrections in English and the machine will translate them into alterations of the Labanotation score. As Badler notes, "our goal is to have an interactive system. With Labanotation you have this checking facility or proofreading so that you can check the notation against the recreated movement done on the film and, by watching the animation, see if it conforms to the movement the notator saw originally."

The animation would assist the performer, too, so he or she could learn a role, seeing it 'danced' by the model from multiple viewpoints and in relation to a partner or ensemble. Another major development which O'Rourke is exploring is a decompiler which will work in reverse by reading a dance film and recording the body's position on successive frames, translating this back into Labanotation.

Smoliar's hypthetical ballet studio of the future would be filled with cameras. "However," he cautions, "rather than merely videotaping a dance, they will be feeding input to a computer which will produce a Labanotation score. The score can then be played back as an animation available to both choreographer and dancers as a memory refresher."

Besides its practical use as a teaching and memory aid, the computer can also be programmed to generate choreography, albeit in a limited way. John Lansdown, a computer scientist in London, had a computer create and score a dance using certain procedural techniques and established notation for scoring. He came up with a tree of possible transitions and their probabilities (non-probalistic modifiers were used to keep dancers from going out of view or falling off the stage). Working from a set of positions within the anatomic range of the dance troupe he collaborated with, he arrived at a framework consisting of peaks of movement, leaving it up to the dancers to link these peaks together.



Withrow's stick figure model.

In a feasibility study conducted at Rutger's University by student Sanford Ressler under the aegis of Assistant Art Professor, Philip Orenstein, three films were made using stick figures with stored positions that the computer could recall on a screen. The computer could generate at random figures in those positions, making transformations from one to another by using intermediate steps. As Orenstein explains, "you could have the machine keep assembling positions with transformations all day. The next step, then, would be a system capable of artificial intelligence."

Appointed director of Rutger's new Computer Arts Center, he will be examining the ways in which computer technology can serve the artist. Commenting on Ressler's

movies, he predicts, "you'll eventually have a figure on the computer with voice commands. The computer will synthesize brain control, telling the figure to walk. Instead of having an animated figure pirouette, it will behave like a drawn figure, bypassing Labanotation altogether."

Like Smoliar he sees many video cameras set up in a studio to record movement with the computer calculating the light source, shadows, and placement of the bodies in space from various sides. One could even rotate the figure at the machine's command. "One of the innovative aspects of this set up," Orenstein says, "is that an algorhythm, or set of rules, translates into a choreographer's style. The idea is to synthesize that style into a rule.

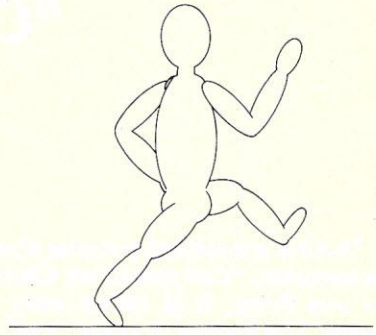
You can devise the hardware, in this case an integrated circuit chip, to do walking instructions and if necessary change the instructions from what was stored the day before."

Capturing stylistic differences of choreographers is significant for dancers and a challenge for researchers as well. In Smoliar's eyes, "labanotation symbols are like words, not letters. Interpreters as they scan a dance score see clusters of symbols and recognize movement patterns immediately. There's enough material to be obtained from Martha Graham to make 'words' of her style. The computer can, with a refined language like Labanotation, distinguish a Graham from a Cunningham walk. It's analogous to the different ways a Back fugue sounds when played on a clavichord and a piano."

Research thus far has concentrated on the skeleton rather than the musculature of the body and the field of study known as effort/shape, also pioneered by Laban, warrants closer scrutiny, scientists admit. They are venturing into the area of dynamics, dealing with the way one phrases a set of movements—that is, producing a smooth transition or a stop-start effect—and asking whether the muscles should accelerate or decelerate. Badler, eager to dispel any false optimism adds, "I don't want to be put in the position of claiming we'll give performance quality with a computer animation. Personal style will be a matter of embellishments left to the dancers and choreographer. At the most, I see the computer as a choreographic tool for measuring movement."

Looking into the future with the emergence of the film decompiler, ballet scores may be available on cassettes, stored in a central library. With a home computer, the average dance buff may be able to dial a digitized code to the library's terminal and receive a complete Balanchine, Graham or Ashton opus to watch at leisure. With one's own stick figure on the home screen, manipulating it through Labanotation symbols initiated by English voice commands, one will be able to put together one's own ballet.

But overriding these goals are the immediate concerns of scientists trying to put technology at the service of the dance community. Calvert wants to know the minimum computer system that would be useful to schools of dance. Smoliar surmises, "It would take five years to set up a system usable by a dance company if the funding came in today. The results we have now took three years of discussion and work and we were just fortunate to have the best people around to set up these programs."



Herbison and Evans "Sausage Woman" body model.

Summing up the present situation, he compares it to chemistry. "Once the elements were discovered," he explains, "it meant you could play around with the periodic table and predict certain chemical events. With dance notation languages in the computer as stored information, you can play around with certain symbols and modifiers and get dance sequences.

"Or take music. You wouldn't expect members of an orchestra to learn the parts for their instruments by listening to a recording of a symphony. They use musical scores. Well dancers, too, should have access to a permanent visual record they can refer to. All I'm saying is, isn't it about time the study of dance was afforded the same delving into as the study of music?"

As he and other computer scientists have already demonstrated, the answer is definitely affirmative. □

The Controversy Goes On — "Can Computers Think?"

Part I: Background

Peter Kugel

There is something peculiar about the question, "Can machines think?" For one thing, it is rather easy to answer. The answer is either "yes" or "no" and you can flip a coin and have a fifty-fifty chance of being right. If you agree with what I am going to say in these articles, then both answers are right and you have no chance of being wrong.

On the other hand, some computer scientists, and quite a number of philosophers, doubt if computers will ever be able to think. Computing and thinking, they argue, are two different kinds of things.

Some people take the question quite seriously. Perhaps it is because they feel that thinking is so very hard to do. Certainly people go to great lengths to avoid doing it, and I know people who seem unable to do it at all.

Perhaps people take the question so seriously because they like questions that have only two possible answers like "Do you think it is going to rain?" or "Who do you think is going to win the game?" Such questions are good as conversation starters because they allow most anybody to say something sensible in reply. And, at least in the case of "Can computers think?" neither a "yes" or a "no" answer is obviously wrong. There is something to be said in favor of either answer.

People who feel that machines can think point to that thing we carry on our shoulders and ask, "If that's not a machine, then what is it?" Marvin Minsky of M.I.T. once suggested what kind of machine he thought it was—a computer that happened to be made out of meat. And the people who feel that machines will eventually be able to think, forsee a time when thinking machines will do our work for us, teach us, play with us, mow our lawns and cook our dinners.

People who feel that machines will never be able to think, point out the dumb things that computers do — those "final notices" that they produce for outstanding debts of $00.00 and the hilarious mistakes that they make in dealing with the programs we write for them. "If machines are so smart," these people ask, "then why do they do such stupid things?" And those who hate (or fear) the prospect of thinking machines fear a world populated by slow moving, unfeeling and clunky machines wandering around, spilling our drinks, stepping on our toes, blowing up cities by mistake and ending up in some sort of a loop, some sort of a loop, some sort of a loop,...

The controversy over whether or not machines can think has attracted the attention of philosophers, psychologists, neurologists, computer scientists and writers of science fiction. The writers have probably had the most fun with it. They have worried less about which side was right than they have about what would happen if machines really could think.

Long before the computer was invented, Ambrose Bierce wondered what would happen if we had a smart machine that followed the orders we gave it literally rather than thinking about what they meant. In his story "Moxon's Master," he has Moxon build a machine which is instructed to try to win a game of chess. Sounds harmless, but when the machine starts to lose it can see only one way of avoiding a checkmate. It kills Moxon. (Today, we would call that a "fatal bug.")

Fred Brown, in his story "Answer," wondered what would happen if computers became really smart. When asked "Is there a God?" Brown's super-smart computer makes sure that it cannot be unplugged and then replies **"Now** there is."

Isaac Asimov worried about how we would control our thinking machines. Arthur Clarke wondered what would happen if we could not control them. (Remember HAL in "2001"?) And Robert Heinlein wondered where computer programs went when they were "no longer with us."

It is relatively easy to read a piece of science fiction and imagine a thinking computer. It is a bit harder to make one. Since the digital computer is today's outstanding candidate for the role of an intelligent machine, the work of making (or programming) a thinking machine probably falls to the computer scientists. Most computer scientists, being scientists and not yet having seen a thinking computer, tend to keep an open mind. If forced to give a one word answer to the question "Can computers think?" most of them would say "maybe," although many of them might add, under their breaths, "but probably yes."

Those who are more certain that the answer is "Yes" and feel that it is only a matter of time before we have some thinking computers around, can point to some pretty impressive examples of more or less intelligent computer programs. Computers today can play superb kalah, excellent checkers and better chess than I can. They can do pretty well on problems from IQ tests and they can do college level calculus problems a lot better than most college students. They have discovered mathematical theorems and can do some medical thinking better than the average doctor.

The computer scientist says something like this: "You want to know what goes on inside your head? Then pay no attention to your head at all but try to get a machine to do the same things that you do."

Prof. Peter Kugel, Computer Sciences, Boston College, Chestnut Hill, MA 02167.

Controversy, con't...

On the other hand, some computer scientists, and quite a number of philosophers, doubt if computers will ever be able to think. Computing and thinking, they argue, are two different kinds of things. Although both are kinds of information processing, they require different kinds of machinery. Computers have the machinery to enable them to compute and people have the "machinery" with which to think. Computers are mechanical, precise and cold. People are intuitive, somewhat imprecise and warm. You may be able to get a computer to fake some kinds of thinking, but what they do turns out to be rather limited and not always trustworthy. So according to these people, the answer to the question "Can computers think?" is "No."

Those who feel that computers will never think, can point to plenty of exaggerated claims and subsequent failures. Although computers play decent chess, they do not play it at world championship level (yet). Herbert Simon of Carnegie-Mellon once predicted that a computer would be world chess champion in ten years, but that was more than ten years ago and no computer is a world chess champion.

In addition to the three answers "Yes," "No" and "Maybe," there is a fourth point of view which sees the question as a waste of time. Some philosophers argue that it is too vague and some computer scientists argue that it is too philosophical.

The controversy centers around which of these four answers is right. I have been thinking about this controversy in the light of some recent results in theoretical computer and it seems that the correct answer is none of the above. The correct answer is the first three answers "Yes," "No" and "Maybe" are all correct and the fourth answer ("So what!") is wrong. The question "Can computers think?" is interesting and important. The correct answer ti it sheds light on the nature of thinking and suggests some interesting, though, possibly useless ways of extending the power of the computer.

Before we turn to my answer, let us look a bit at the question. We shall begin with its psychology and ask ourselves, "Why do people get so excited over the possibility of computers thinking?" One reason that we have to rule out is that they get excited over it because it suggests another example of a man-made machine imitating something "natural." If that were the reason, then people would get just as excited over the question "Can cars gallop?" because they would have to do that to imitate completely the horse that they now replace. As far as I know, there is no great interest in developing artificial horses. Nor do people get excited over the question "Can computers think?" because it is another case of the machine imitating something uniquely human. If that were their reason, they would get just as excited over "Can machines sew?" because

If you found that this dumb machine could do this impressive thing called "thinking" then thinking wouldn't be so impressive.

that is something in which people take pride and, as far as I know, it is something that sets humans apart from animals just as much as their thinking ability supposedly does. But everyone accepts the existence of sewing machines. People do seem to be prouder of their ability to think than to sew and this pride does seem to have something to do with why they get so excited over the prospect of a thinking computer.

So what is one to do if one wants to develop a precise account of thinking? One solution occurred to a group of psychologists called "behaviorists." A thinker, they argued, looks like the following diagram.

INPUTS→THINKER→OUTPUTS

Since you cannot look at what goes on inside the box, argues the behaviorist, ignore it. Look only at what goes in and what comes out.

Although, it is not hard to see what drives people to this view, it is rather curious. How curious it is becomes apparent when you try to use a similar method to give an account of sex. A behaviorist might describe sex as a procedure for rumpling up beds.

But one cannot help asking "What goes on in between the inputs and outputs? What happens in the 'black box' in the middle?" To this the neurologist has an amusing answer. He or she takes out his or her trephine, cuts open the head of a cadaver and says, "Look. Here it is, a thinking thing." And if you then reply that you cannot see anything, the neurologist cuts you a slice and shows it to you under the microscope so that you can see it better.

Faced with the behaviorist or the neurologist, it is little wonder that many people are happy to turn to the computer scientist.

The computer scientist says something like this: "You want to know what goes on inside your head? Then pay no attention to your head at all but try to get a machine to do the same things that you do. When you succeed, look at the insides of the machine and understand. And, if by chance the machines you get to think do not think in the same way that you think, then at least you will end up with some possibly useful machines when you are finished."

At first glance, it sounds rather silly to try to understand the human mind by trying to program a computer to do the same things the mind does, but it is certainly no worse than the ideas of the behaviorist or the neurologist. Actually, it is a good deal better. It is very much in the spirit of the traditional scientific method.

When a scientist tries to understand something like the way things fall, he or she constructs a mathematical (or other kind of) model, perhaps in the form of an equation. What this model does is to tell you what a falling body does and to the degrees it does this, it is a theory of that falling body. Similarly, a computer program can be a model of human thinking and serve in much the same way as the physcist's equation. You plug values into the variables of the equation and it tells you how something will fall. You plug inputs into a computer program that models thinking, and the program tells you what a thinker would do with those inputs.

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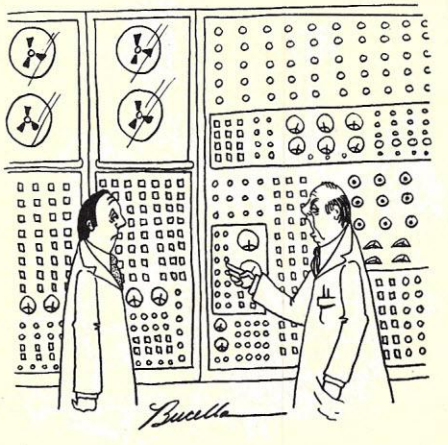

"We spent a fortune on the damn thing and it doesn't even know how to play charades!"

Controversy, con't...

Well and good, but some critics still ask whether you can actually build a machine that thinks. Moxon, the protagonist of Ambrose Bierce's story "Moxon's Master" has a good answer to this. When the story's narrator says to Moxon, "Are you serious? Do you really believe that a machine (can) think?" Moxon replies:

"What is a 'machine'? The word has been variously defined. Here is one definition from a popular dictionary: 'Any instrument or oganization by which power is applied and made effective, or a desired effect produced.' Well, then, is not a man machine? And you will admit that he thinks—or thinks he thinks."

There is something enormously plausible about this argument and, bouyed by it, people have, for a number of centuries, tried to build, or at least design, thinking machines. By and large they have failed and one could write a long article about the silly things that they have suggested while failing. Lucretius tried to give an account of thinking in terms of very small billiard balls that he called "atoms." Those atoms are useful for explaining many things, but thinking is not one of them.

Descartes tried to give an account of thinking in terms of the machinery of the cuckoo clock and failed. As a result of his failure, he came up with an account of the mind that, were it not the basis for most subsequent thinking about the subject, would be suitable only as a running gag in a Woody Allen movie. Sigmund Freud tried to give an account based on what was the most impressive machinery of his time, the sewer system of Vienna. You can find out more about it for about $50 an hour even though it is hard to find anybody to say exactly what Freud's theory says.

"Hey, Sam, is this [barcode] *or* [barcode] *?"*

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One of the attitudes that people do not have toward their own thinking is modesty so that it is not surprising that they tend to try to model their thinking abilities in terms of the most powerful machinery available of the time. It might seem that the current fad of trying to get a computer to think is just a continuation of this sort of thing. Descartes tried using the cuckoo clock because that was the most powerful machinery of his day. Freud used the sewer system because such systems seemed impressive to him. And, we try to get a computer to think just because it is the latest and most impressive machine.

If that were all there were to it, attempts to build thinking computers would still be interesting because they might succeed. But, there is more to it than that and this "more" makes the whole question more important today than it was in the past. Finally, we have a machine, the computer, that is different in kind from the machines used in the past for the purpose of trying to build a thinking machine.

The computer is, for reasons that I will go into in a moment, the ultimate machine in the following sense: IF A COMPUTER CAN'T THINK, THEN NO MACHINE CAN THINK. This follows from a theorem and a thesis, both suggested by the British mathematician A.M. Turing. Together the theorem and the thesis imply that any information processing which can be done by any machine at all, can be done by a computing machine. It is because it now looks as though we are either going to make a thinking machine with the computer or we will never make one with a machine, that the issue has begun to heat up in recent years.

The importance of the controversy waxes and wanes. Recently it has begun to wax. Two books about it, one by Hubert Dreyfus of the University of California at Berkeley and the other by Joseph Weizenbaum of M.I.T. were alternate selections of the "Book of the Month Club." Discussions of the controversy are appearing in newspapers, magazines and on TV programs.

One of the things that makes this controversy seem so odd is that it is possible that both sides are really arguing for the same thing. Both sides seem to be trying to prove that human thinking is a pretty good thing.

Those who argue that computers **cannot** think seem to be arguing like this: Thinking is a pretty impressive thing, while the computer is only a dumb machine. (If you've ever tried to program one, you know how dumb it can get.) If you found that this dumb machine could do this impressive thing called "thinking" then thinking wouldn't be so impressive.

Those who argue that computers **can** think, on the other hand, argue from the same premise. Thinking is a pretty impressive thing, so that thinking should eventually be able to understand anything. But surely that includes thinking itself. They then argue that if thinking is to be understood, it must be possible to write a computer program to do it. And so they come to the opposite conclusion from the same premise. We have here what the logicians call a "paradox" — a way of getting two apparently contradictory conclusions from the same assumption. A famous paradox of this sort is the paradox of the liar.

What Turing was trying to do in his article was to define the question "Can computers think?" in such a way that people could get to work on it in ways that were more productive than just discussing it philosophically over a glass of beer.

A.M. Turing, in a famous paper published in 1950 (Alan M. Turing. "Computing Machinery and Intelligence," **Mind**, 1950), gave a good working definition of what ought to count as information processing in defining this question. He suggested that what ought to count was the kinds of behavior that could be transmitted over a teletypewriter. Now, this is a very strongly behavioral definition of "thinking." It says that the only things that are to count as thinking are what we can see on the outside and there are many people who do not find that this includes enough. For them, what goes on inside counts too.

Of course it counts, but it makes sense to ask whether computers can duplicate the outward appearance of the information processing behavior that people do when they are said to think. If they could, it might not be the end of the "Can computers think?" controversy because people could

Controversy, con't...

still argue about "internal" differences, but it would be an important step forward.

Now, it might be worth stopping at this point to notice that a thinking computer even at this strictly behavioral level, might not be a good thing to have around and one might argue that the answer to the question "Can we program a computer to think?" should be postulated to be "No" simply to prevent people from developing machines that would do our thinking for us (and probably put most of us out of a job). Although there is something to be said in favor of this view, few people are strongly swayed by it and it certainly does not answer the more or less factual question of whether or not the programming of thinking computers is actually possible. This factual question is a scientific, or at least an engineering, question. It is something mathematicians, scientists, or engineers can sink their teeth into. What Turing was trying to do in his article was to define the question "Can computers think?" in such a way that people could get to work on it in ways that were more productive than just discussing it philosophically over a glass of beer.

To see why Turing's formulation of this question was so significant, we have to take a look at the history of the computer and of the mathematical development that led to it. Much of this story revolves around Turing. Turing appears three times in the history of the question "Can computers think?" He appears the first time as a mathematician when he comes up, in 1936, with a mathematically precise definition of what information processing machines can do and with an important theorem about it. He appears the second time as an engineer when he helps to build one of the world's first electronic computers that helps turn the question into a practical one. And finally, he fashions the modern version of this question in his 1950 paper when he appears as a philosopher, suggesting a precise way to handle the word "think" in the question "Can computers think?"

Back in the 1930's various people were asking themselves what kinds of information processing could and could not be done by "strictly mechanical means." Actually, this is quite an old question. The German philosopher Leibnitz was asking it in the 17th Century. Leibnitz tried to develop a universal symbolic system in terms of which he could represent all human knowledge and a general purpose mechanical reasoning procedure based on it. He failed, but in the process he invented modern symbolic logic, suggested the idea of the digital computer and in his spare time invented (as Newton was also inventing it) the calculus.

What interested Leibnitz about such a universal system for representing our thoughts, and in mechanical procedure for manipulating the resulting representations, was the hope that this mechanical procedure could be then used to derive new truths from old ones, much as simple arithmetic allows us to go from the facts that we had two oranges and somebody has just given us two more to the fact that we then have four oranges.

Leibnitz's question "Can we represent all human thinking by means of simple symbolic system that we can then manipulate mechanically?" was revived in the 20th Century by Hilbert. Hilbert was a German mathematician and he knew about the kinds of computations we use when we add, multiply and do long division by hand. They consist of procedures that operate on symbols in well defined, and rather mechanical, ways to produce answers. Hilbert asked: "Can we develop such mechanical ways to operate on symbols that will not only answer such questions as '345/543 = ?' but more serious mathematical questions as well?"

Everyone knew roughly what was meant by "a mechanical procedure" and Hilbert was having considerable success in developing procedures for mechanizing all mathematics. Hilbert kept coming closer and closer but he never seemed to get a complete mechanical procedure. By the early 1930's the suspicion began to arise that he might never get there because what he was trying to do was impossible. Now, as long as you are simply trying to do something by means of a computation, you don't really need a definition of what a computation is. You use anything that comes to mind if it seems computational enough to you.

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"You'll have to forgive Howard. He was just positive you were bringing the floppy disk he ordered last week."

It won't do to argue that something can't be done by a computation just because nobody has found a computation to do it yet.

But things are different if you are trying to prove that something is impossible to do by any kind of computation. It won't do to argue that something can't be done by a computation just because nobody has found a computation to do it yet. You need a precise definition that specifies exactly what does and does not count as a computation so that you can attempt a rigorous mathematical proof of the suggested impossibility.

It was not as easy as to give a precise definition of a computation as it might appear. Many attempts were made but they always seemed to leave something out that was, quite clearly, a computation. Turing, in 1936, was one of the first people to succeed in producing a definition that we now believe did not leave anything out. At least today, we know of nothing that seems, intuitively, to be a computation that his definition overlooks.

Turing defined the idea of a computation in terms of some imaginary machines that we now call "Turing machines." These machines were very simple in that they involved only quite elementary machinery but Turing showed how the simple parts of these machines could be put together into much more complicated machines that could do everything that anybody up to that time had thought ought to count as a computation. In a sense, then, what Turing did was to find some "atoms" of information processing and in terms of these elements he gave a formal (or mathematical) definition of a "computation":

A **computation**, or strictly mechanical piece of information processing, is anything that a Turing machine can do and furthermore, anything that such a machine cannot do is strictly mechanical.

Controversy, con't...

Because Turing's machines were so simple, almost everybody agreed that the positive part of this definition did not go too far. If a Turing machine could do something, then it clearly counted as a computation. What was not so obvious was the second or negative part of the definition. It was not clear that every computation could be done by a Turing machine. Turing conjectured that it could and this claim has come to be known as "Turing's Thesis" (and also as "Church's Thesis" after Alonzo Church of Princeton who proposed much the same thing at approximately the same time):

TURING'S THESIS: Anything that can be intuitively computed by anything, can be computed by the rather simple, and well defined, Turing machines.

There is really no way to prove this thesis because it compares a precise definition of "computation" (in terms of the Turing machines) with a vague intuitive one. Previous theses of a similar sort had been disproved by means of counter-examples. The most sensible idea before Turing's had been disproved by Ackermann who produced a function that could clearly be computed (and when you try to compute it even for small inputs, it will drive your computer up a wall) but didn't fit under that older definition.

Turing's definition has evaded all the counter-examples that people have tried to throw at it. Nobody that I know of has yet come up with a process that seems, intuitively, to be a computation but that one of Turing's machines can't duplicate.

But the trick was turned at a cost. Turing allowed into the scope of his definition, certain kinds of operations that did not really seem to be computations because they did not always produce results. (One would hardly call procedures with this property acceptable computer programs even today.) It turns out that unless you allow such operations into your definition (and your definition meets certain other natural requirements), you must always leave something out and your definition must, thus, remain incomplete.

If a computer cannot think, then thinking seems impossible by any conceivable mechanical means.

Turing's machines were only mathematical abstractions but it occurred to a number of people that, since the "atoms" of which they were constructed were so simple, it might be possible to build such machines. Before computers were actually built, however, Turing asked himself an important question about them: "How many different computing machines do we have to build if we want to cover all the bases or to have machines that can do **all** the information processing jobs that can be done mechanically?"

Suppose, for example, we were to ask the same thing about transportation machines. How many different kinds of transportation machines would we have to build before we had a machine that could get us everywhere any machine could get us? This would be a hard question to answer but surely one would have to build a few different ones - something to go on land, something to go in the air, something for space, something else for going under water, and what have you.

But Turing's question had a different answer. He proved a theorem that said that, in the realm of computation, there is a single, all-purpose machine and, if you build one of these, it can do anything that any other computing machine can do by simply programming it appropriately. Such machines, that can do anything that any Turing machine can do, are called "Universal Turing Machines." Any computer built today has the theoretical power of such a machine.

Now let's put these things together. First of all we have this thesis that says: Anything that can be done by strictly mechanical means can be done by a Turing machine. Then we have this theorem that says: Anything that can be done by a Turing machine (of any kind) can be done by a single Turing machine (and hence by any general purpose computer there is). From these two things, it follows quite straightforwardly that if a general purpose computer **cannot** do something (say thinking) then that thing cannot be done by mechanical means at all.

Notice how this differs from the claim that something can't be done by the mechanical means available to us at a given time. The cars and airplanes available in the early part of the 20th Century were not adequate, even in principle, to take man to the moon. But it did not follow from this that no machine could do this job. The situation now seems to be different with respect to thinking and computers. If a computer cannot think, then thinking seems impossible by any conceivable mechanical means.

Now look back at the argument given by the narrator of Bierce's story "Moxon's Master." If we decide that a machine can't think (which follows from the claim that computers can't think, by Turing's thesis) then it seems to follow that we, who can think, must contain non-mechanical or non-physical components of some sort - perhaps a ghostly something that wobbles about in our hearts, our heads or our pineal glands. Many people find this conclusion abhorrent and so they feel very strongly that the premise from which it seems to follow: "Computers can never never think" must simply be false.

But there is even more here that upsets people. It can be argued that if computers can't think, then no scientific account of thinking is possible so that thinking can never be scientifically understood and must remain a mystery. This follows if we accept, as many people do, the claim that any scientific account of thinking must, at heart, be a mechanical account or, to put the same thing in slightly different words, that any account of thinking that could be made sufficiently precise could be used to write a thinking computer program. A negative answer to the question "Can computers think?" thus seems to imply not only that we have within us some supernatural spirit but one that is, somehow beyond the grasp of science or reason.

This situation seems to pose a dilemma for those who hold rational thinking in high esteem. Either computers can think, in which case not only are we wonderful rational thinkers no better than some mere machine, or computers cannot think in which case thinking is beyond the range of rational thought. Either way, the value of rational thought seems compromised.

This is roughly where the "Can machines think?" controversy stood on the eve of World War II. During that war, the digital computer was invented and the imaginary Turing machines became real machines. This considerably changed the complexion of the controversy in ways that I will discuss in the next part of this article. □

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New Tools In Investment Analysis: Cybernetics & Artificial Intelligence

Jerry Felsen, Ph.D.

Machines don't think—they only carry out orders, hopefully issued by people who think.

Since cybernetics and artificial intelligence techniques are central to the design of viable man-computer investment decision systems, let's briefly examine these disciplines.

Cybernetics has been defined as the interdisciplinary science of communication and control in the animal and machine. Its major province is the study of systems which may be exceedingly complex and dynamic... to the extent of perhaps defying a full description. But these are exactly the sort of systems faced by the investment analyst.

The cybernetic approach to investment analysis was not feasible earlier because we had no suitable mathematical techniques for efficient processing of the extremely complex information patterns characterizing the stock market. But some of the most recent developments in artificial intelligence, especially in pattern recognition and machine learning, enable us to realize effective methods for efficiently synthesizing all relevant information into the best investment decisions. This enables us to formulate new investment techniques which do not have many of the limitations of conventional methods.

The stock market is a very large, complex, and dynamic system, but this large system turns out to be no more than a part of an exceedingly large system, and classical mathematical (statistical) techniques do not deal with these systems very successfully. Thus the stock market (SM) is a part of the system of U.S. security markets, which is a part of the national economy which, in turn, is interrelated with the rest of the world. The market is also affected by the investing public, the political power structure and so forth. All of these system elements interact mutually and dynamically in an unpredictable manner. The nature of these interrelationships is poorly understood, and the structure of the system cannot be described in operational terms. But this is exactly the type of problem situation studied by the science of cybernetics.

The cybernetician regards the stock market as a complex, viable, dynamic, and adaptive system. It can change its internal structure in response to changes in its environment. It maintains multiple contact with its environment, and it can adapt to unforeseen circumstances. It follows that a decision system that operates in the stock market environment, in order to be successful, must possess similar viable characteristics. It must be able to learn and to adapt to changes in the market environment.

A basic cybernetic principle, the **law of requisite variety**, then assures us that the variety (i.e., complexity) of the mechanism for investment analysis must approach the variety of the system to be analyzed, if analysis is to be successful. This means that the investment decision system must consider all relevant factors affecting the market. This concept is very important. Variety in the real world is handled by an equivalent variety in the decision system and cannot be competently handled by less. We frequently mislead ourselves into thinking that we can outwit the natural law of requisite variety in the stock market, just as many imagine that they can beat other natural laws at the racetrack or at the casino. The existence of such laws must be accepted and we must face up to their consequences. This means that complex, high-variety decision problems cannot be solved effectively by simple, low variety methods.

Hence, to isolate the stock market artificially from its environment (e.g., by using simple models to describe it as is often done in stock market analysis to simplify the problem) is also to rob the investment decision system of its viability. Yet, how often are investment decisions based only on a few isolated pieces of information which characterize only a tiny segment of the decision situation as is done, for example, in technical analysis?

No approach to investment analysis can be very successful unless it conforms with the law of requisite variety. Thus the investment decision system must attain certain viable characteristics of the environment in which it operates. In particular, it must reach a high level of complexity before it can be successful. It follows at once that simple investment techniques that use only a small segment of the information spectrum characterizing the market cannot be very profitable. Specifically, it follows that the purely technical approach cannot be very successful. Similarly, the fundamental approach which considers only earnings and dividends in investment analysis cannot yield very good results. One of the important missing elements are **psychological factors** in the market place. For instance, increases in earnings are often more than offset marketwise by a decrease in the public regard for the stock in the interim, and stock prices then may move in a direction opposite to the earnings trend.

The cybernetician regards the stock market as a complex, viable, dynamic, and adaptive system. It can change its internal structure in response to changes in its environment.

A study of most conventional investment techniques shows that they use only a small segment of the information spectrum characterizing

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the market. In other words, **they are essentially information - destroying and variety-compressing procedures**, and therefore their usefulness is rather limited. Clearly, there is a need for an integrated systems approach that incorporates at least fundamental techniques, psychological measurements and technical methods.

The development of cybernetic investment decision systems is accomplished with the aid of artificial intelligence techniques. Artificial intelligence (AI) is the advanced form of both computer sciences and cybernetics. Its goal is to construct (usually computer-based) machines which exhibit behavior that we call "intelligent behavior" when we observe it in human beings. Hence, AI has been defined as the totality of attempts to make and understand machines that are able to perform tasks that, until recently, only human beings could perform, and perform them with effectiveness and speed comparable to a human.

Artificial intelligence is an exceptionally complex discipline, and a voluminous body of literature is available on this subject. Space limitations do not allow us to review the relevant literature here, but a brief summary of the relevant AI techniques together with a useful AI bibliography can be found in a book by this author (Felsen, 1976).

The main ingredient of intelligent behavior displayed by advanced cybernetic systems are the abilities of problem solving, learning and pattern recognition. Consequently, we will be concerned with the three corresponding central aspects of artificial intelligence: (heuristic) problem-solving methods, learning system theory, and pattern recognition. Since we will not go into the details of implementation of our cybernetic investment decision systems, we will not consider heuristic programming here.

We have made a thorough theoretical study of applications of cybernetic concepts and AI techniques to investment analysis in the early 1970's. The results of this research have been described in two books: **Cybernetic Approach to Stock Market Analysis versus Efficient Market Theory** (Felsen, 1975), and **Decision Making Under Uncertainty: An Artificial Intelligence Approach** (Felsen, 1976).

The results of our research leads us to believe that when we attempt to use computers to support problem solving or decision making (PS/DM) in **unstructured judgmental situations**, the computer should be used to **augment rather than replace** human intellect. (By "unstructured judgmental situations" we mean complex, real-life problems that cannot be easily captured by mathematical models so that some parts of the PS/DM process must be performed by the human operator who may have to use intuition or judgment.) So the human operator must remain a part of the computer-based PS/DM system. This is because, in the foreseeable future, it will not be possible to automate or program realistic judmental PS/DM situations fully, not even with artificial intelligence techniques. Consequently, we must build our PS/DM systems as man-computer systems where man and computer complement each other so that each partner performs only those tasks which they can do most effectively. The computer then augments or supports rather than replaces human judgment.

By augmenting or amplifying human intellect we mean: 1. delegating to the computer processing of those information patterns which are too complex for the human mind to handle; 2. making minds to work better by giving them better tools with which to work; and, 3. maximizing the benefits of man-computer synergism.

In short, we attempt to build decision systems in which man and computer work together as partners and the computer supports rather than replaces human judgment. Our aim is to draw on the best capabilities of both man and the computer. And we may maximize man-computer synergism by combining the best features of both man and the computer so that each performs only those functions which each can do most effectively. Performance of the combined man-computer system may then become better than the sum of results from both components taken independently of each other. In other words, the man-computer system can attain superior investment performance than either partner could achieve alone. Thus, although neither the human analyst alone nor the computer alone can consistently outperform the market averages, the combined man-computer decisions system may be able to do so.

The main ingredient of intelligent behavior displayed by advanced cybernetic systems are the abilities of problem solving, learning and pattern recognition.

A Learning Investment Decision Model

Decision making is the process of converting information into action. The investor has a certain amount of information about the general market and some individual stocks and he has a choice among several well-defined courses of action (investment policies). Typical investment policies include buy, sell, hold, do nothing, sell short, etc. The investment decision process then consists of selecting the best investment policy using available information.

Although neither the human analyst alone nor the computer alone can consistently outperform the market averages, the combined man-computer decisions system may be able to do so.

Each investment policy is characterized by a different pattern of information. For example, a stock considered for sale may have a declining earnings trend, high price earnings ratio, limited growth prospects, or pays low dividends. On the other hand, a stock we would like to buy may have a rising earnings trend, good long-term growth potential, relatively low price earnings ratio,

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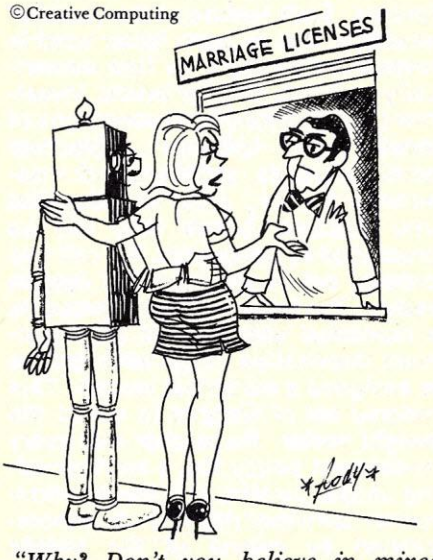

"Why? Don't you believe in mixed marriages?"

Investment, con't....

innovative management, rising price trend on its charts and so forth. So there is a one-to-one correspondence between different patterns of information and different investment policies. Investment analysis, therefore, involves **pattern recognition**. And, selecting an investment policy corresponds to recognizing the "correct" information pattern. Hence, the investment decision process can be programmed or automated with the aid of pattern recognition (PR) techniques.

Both investment timing and selection decisions are made by weighing evidence. For example, investment selection decisions are synthesized from observations of earnings and dividends trends, price earnings ratios, from technical analysis, through measurements of the underlying psychological factors and other factors. Similarly, market forecasts (investment timing decisions) are made by weighing evidence obtained through an analysis of the market's fundamentals (monetary, political and economic), technical factors, psychological measurements, observations of the news background and so on.

Several PR techniques have been developed with are suitable for programming decision making by weighing evidence (DMWE). The most useful of them are known as **linear discriminant** techniques. They are computationally simple, need little memory, and can, therefore, be easily realized with personal computers. So these PR schemes became the heart of our programmed investment decision models.

Our decision models operate as follows: Each feature of the decision situation, that is, each factor used in investment analysis, is first numerically encoded. In other words, investment information like observations of stock market indicators, corporate earnings trends, psychological measurements, etc., must be converted into numbers before they can be processed by computers. We call this ordered set of numbers the **feature vector**. The feature vector represents a numerical encoding of **all** investment information. Then each feature is assigned a numerical weight. This ordered set of weights is called the **weight vector**. Remember that every investment policy has a corresponding unique pattern, and the discrimination between patterns is accomplished by means of the weight vectors. So we need one weight vector for each investment policy. When the time comes to make investment decisions, we form the product of the feature vector with all weight vectors. That is, for each investment policy we form the product of each pattern feature with its corresponding weight and add them up. These sums are the values of the discriminants corresponding to the alternative investment policies. We then select and carry out that policy whose discriminant is largest.

The stock market and its environment is an extremely complex mechanism. Stock prices are influenced by many different factors and the human mind has difficulty coping with such complexities. Consequently, the process which generates stock price changes is poorly understood. Therefore we are unable to design "good" investment decision systems initially. In other words, we do not know what weights should be assigned to the features in the pattern recognition mechanism to obtain good performance. Therefore, at the beginning the PR mechanism will perform poorly (it will make many errors) and many wrong decisions will result. We can, however, gradually improve performance of the decision system during its operation. This can be done by adjusting the weights of the PR mechanism so as to reduce the error rate. These weight adjustments are made under the direction of information feedback and accumulated experience derived through an evaluation of past investment decisions. This process of gradually modifying the programmed decision system so as to improve its performance is called **learning**.

The stock market and its environment is an extremely complex mechanism. Stock prices are influenced by many different factors and the human mind has difficulty coping with such complexities.

The learning process functions this way. At the beginning the weights are set according to our best initial knowledge about what features are known to be important; or, the weights may be picked arbitrarily, e.g., set them all equal to one. Afterwards the weights are changed under the direction of error-correcting feedback derived through performance evaluation of actually made decisions. So the initial design of the decision model is based on our knowledge of all past data about the stock market. This knowledge represents a starting point in the development of the decision system but is usually not sufficient for optimal design. On the other hand, the learning process uses **current information**. Such information is based on direct observation of present stock market characteristics. Current information is renewed at each instant and thus represents the most accurate knowledge of the situation. Only learning based on current knowledge can result in truly optimal performance.

Many computer-oriented learning techniques for performance improvement of PR systems have been developed. We have selected a family of techniques known as **perceptrons**. The perceptron algorithm is a model of "reinforcement learning." It will gradually increase the weights of those features that contribute to improved performance and decrease weights of features that contribute to improved performance and decrease weights of features responsible for deteriorating performance. The learning process is supervised by some performance evaluation mechanism which uses information regarding the correctness or incorrectness of the decisions made by the system. This information is derived by evaluation of outcomes of investment policies after they were carried out. The supervisions of the learning process and system performance evaluation may be performed by the human operator or it may be at least partially automated.

The perceptron PR scheme is the central information processing element of our man-computer investment decision system. The percep-

"He has the mind of a computer — one that's slipped a disc."

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tron has been selected for the following reasons: First, it is the computationally simplest PR technique. Secondly, it requires less information for optimal design than other PR methods. Thirdly, it is well suited for programming decision making by weighing evidence. Moreover, the perceptron can process a large amount of decision making information because there is no limit on the number of features it can handle. This is vital because in investment analysis having more relevant information may result in better investment decisions. In addition, a decision system based on a perceptron scheme is inherently quite reliable in the sense that failures in one or more features may not markedly deteriorate system performance. Much of the information on which investment decisions

Much of the information on which investment decisions are based may be "noisy," that is, it may not be very precise or accurate, and it may be subject to various environmental disturbances.

are based may be "noisy," that is, it may not be very precise or accurate, and it may be subject to various environmental disturbances. Fortunately, the perceptron may continue to function properly even if some piece of the input information is missing or incorrect. In this sense our decision model resembles the human brain: it functions in terms of patterns, and if some elements of the pattern are missing or are corrupted with noise, the brain in effect reconstructs them.

Finally, perceptron-oriented PR systems need very little memory for computer implementation. The memory needs are small because only the weight vector and the most recent feature vector must be stored. In other words, only the information used for the most recent decisions must be remembered for the learning process. Therefore perceptron-based decision systems can be quite easily realized on personal computers.

We will now briefly discuss how the general principles discussed in this section are applied to the desigr of investment decision models These design principles are appli cable to both general market fore casting as well as analysis of particular securities.

General Market Timing

With respect to general market timing, the general market state may be defined in terms of stock price trends and trend reversals. Many different states may be defined. It is convenient to work with four states of the market: uptrend, top, downtrend and bottom.

Many market practitioners are trend followers: they prefer to buy at major market bottoms, hold during the uptrend, sell (or sell short) near a market top, and do nothing (or hold short positions) during a downtrend. Thus trading in the stock market is a recurrent decision process whose policy space contains four well-defined courses of action. We can program this decision process with the aid of PR techniques.

The success of the programmed decision system depends on its ability to predict future direction and changes of trends in stock prices. It is apparently impossible to predict future price changes through an analysis of only past price changes. But if the information pattern for stock market analysis becomes very complex, and includes fundamental data, psychological measurements, news background, etc., in addition to technical factors, then prediction of future price changes appears possible. The information pattern which serves as a basis for investment decisions must necessarily be so complex that the human mind is generally unable to ascertain the correlation between present values of market indicators and future changes in stock prices. But this relationship

"There's nothing I can do about her trouble. You know, these things only look human." ©Creative Computing

can be gradually determined through a machine-learning algorithm.

Our scheme may be regarded as an attempt to program the well-known general indicator approach to stock market timing. This method synthesizes investment decisions by weighing evidence obtained through an analysis of a broad spectrum of indicators, i.e., measurements or observations describing the state of the market. The system can be tailored to the needs of its users. So its design will generally reflect the user's resources such as the type of information to which he has access, his attitudes toward risk and expected return on investments, available computational resources, etc. For these reasons there is an infinite number of possible realizations of man-computer investment decision systems (MCIDS). Our choice has been guided primarily by the requirement of computational simplicity. In fact, our present investment decision system is so simple that all required computations can be efficiently performed by hand.

The decision system operates in four phases. The first phase, the identification activity, consists of searching the environment and

If the information pattern for stock market analysis becomes very complex, and includes fundamental data, psychological measurements, news background, etc., in addition to technical factors, then prediction of future price changes appears possible.

numerically encoding all information characterizing the state of the general market. The relevant information is obtained by monitoring the various fundamental, technical, economical, monetary, and psychological indicators, reading daily newspapers and watching the investment news background. These observations and measurements are represented by the feature vector containing a numerical encoding of individual SM indicators, observations of the news background, psychological measurements, etc. In short, the feature vector contails all the information about the market's past that is relevant for the prediction of its future. The encoding of investment information can be done objectively

Investment, con't....

or subjectively.

Different investment policies are generally used for different time horizons. And different information patterns are needed to predict the market's behavior during different time horizons. Thus, since there are three time horizons, short-, intermediate- and long-term, three feature vectors are needed. For example, in our implementation, the short-term feature vector contains five features, the intermediate-term vector contains seven features and the long term vector contains six features. All information for the identification activity is obtained from the **Wall Street Journal** and **Barron's**.

The mechanism for selecting the investment timing policy is programmed with the aid of discriminate functions of the pattern recognition scheme. Its performance is then gradually optimized through a learning procedure. The theoretical and technical details of its operation are described in our earlier publications.

A security is defined as relatively strong over a given time horizon if it appreciates more than a general market index during that time while entailing no more than average (market) risk, and it is relatively weak otherwise.

An Investment Selection Model

The design of every programmed investment decision system must be tailored to requirements and conditions existing within individual user organizations (e.g., investment research departments). The first step in the design process is to specify the user's investment objectives in operational terms, i.e., a selection criterion must be established. Within the decision system these investment objectives are represented by a performance index.

There are many possible selection (performance) criteria. The relative strength criterion is often used. A security is defined as relatively strong over a given time horizon if it appreciates more than a general market index during that time while entailing no more than average (market) risk, and it is relatively weak otherwise. Clearly, relatively strong issues are characterized by a different information pattern than relatively weak stocks. In other words, this selection criterion divides the set of stocks into two classes: those that are in a relatively strong state and those in a relatively weak state (during a prespecified time horizon). So a two-category pattern classifier can be used to program investment selection according to this criterion.

The second important design step is developing the mechanism for identification of information for decision making in the form of the feature vector. The features may include fundamental characteristics such as earnings trend, earnings stability, future earnings potential, dividend yield, divident trend, price earnings ratio, risk characteristics (i.e., variance of past price changes or the Beta coefficient); technical factors like current price trend on the charts, volume measurements, price overhang psychological factors (e.g., divergence measurements); and, various other factors like news background, capitalization, quality of institutional sponsorship of the security, company's reputation for technical power and research, quality of management and Standard & Poor's rating of the security.

Next the decision rule will be programmed. Let the index n count the number of securities considered for investment. Then the selection rule can be programmed by discriminant functions: select the nth security if the discriminant for the nth security is greater than zero, and discard it otherwise. This rule will associate a selection policy, e.g., buy (hold) or sell (discard), with any pattern of information describing the security. (With this scheme we can also program the individual security's transaction timing).

Finally, the selection rule is optimized through a learning process with the aim of minimizing the probability of error. The learning process functions this way. At the beginning the weights are set according to our best initial knowledge about what features are known to be important; or the weights may be picked arbitrarily, e.g., set them all equal to one. Afterwards the weights are changed under the direction of error-correcting feedback derived through performance evaluation of actually made past stock selections. For example, suppose that the nth security has been selected (bought or held), that is, its discriminant is positive. If this stock subsequently outperforms the market during the prespecified time horizon, the system has made a correct decision. (In this case the weight vector remains unchanged but the counter n is increased by one.) But if the security appreciates less than the market index, a wrong decision was made, and the weight vector is subsequently changed according to a learning algorithm. This "correction" reduces the chance of making a similar poor selection in the future. The system is also "corrected" when a reverse error was made, i.e., when a relatively strong stock was not selected. The new value of the weight vector is then used in subsequent computations until the next error is made.

After some time this step-by-step learning from past experiences may result in real performance improvement. At the start, the system's performance will most likely be only mediocre. But after about twenty learning steps ($n=20$), the system may become close to optimal and may make better decisions than human analyst could do intuitively.

Where To Find Further Information About Learning Investment Decision Models

We have deliberately omitted the technical and mathematical details underlying the design of our investment decision systems. We have done it for two reasons. First, the theory underlying our learning investment decision models is quite complex and its full understanding requires mathematical sophistication of the reader. Also, the needed technical and theoretical details have been quite thoroughly described in the two books mentioned earlier.

Second, the primary purpose of this article is to show how intelligent investment decision support systems can be realized with the aid of low-cost personal computers. And, we would like to make this understandable even to nontechnical readers. Therefore, we have kept this presentation at the general or functional level, and have published the details elsewhere.

Editor's note:

This article is an excerpt from the recently published book, **Low-Cost, Personal Computer Based Investment Decision Systems.** 175 pp., $15. CDS Publishing Company, 84-13 168th St., Jamaica, NY 11432. □

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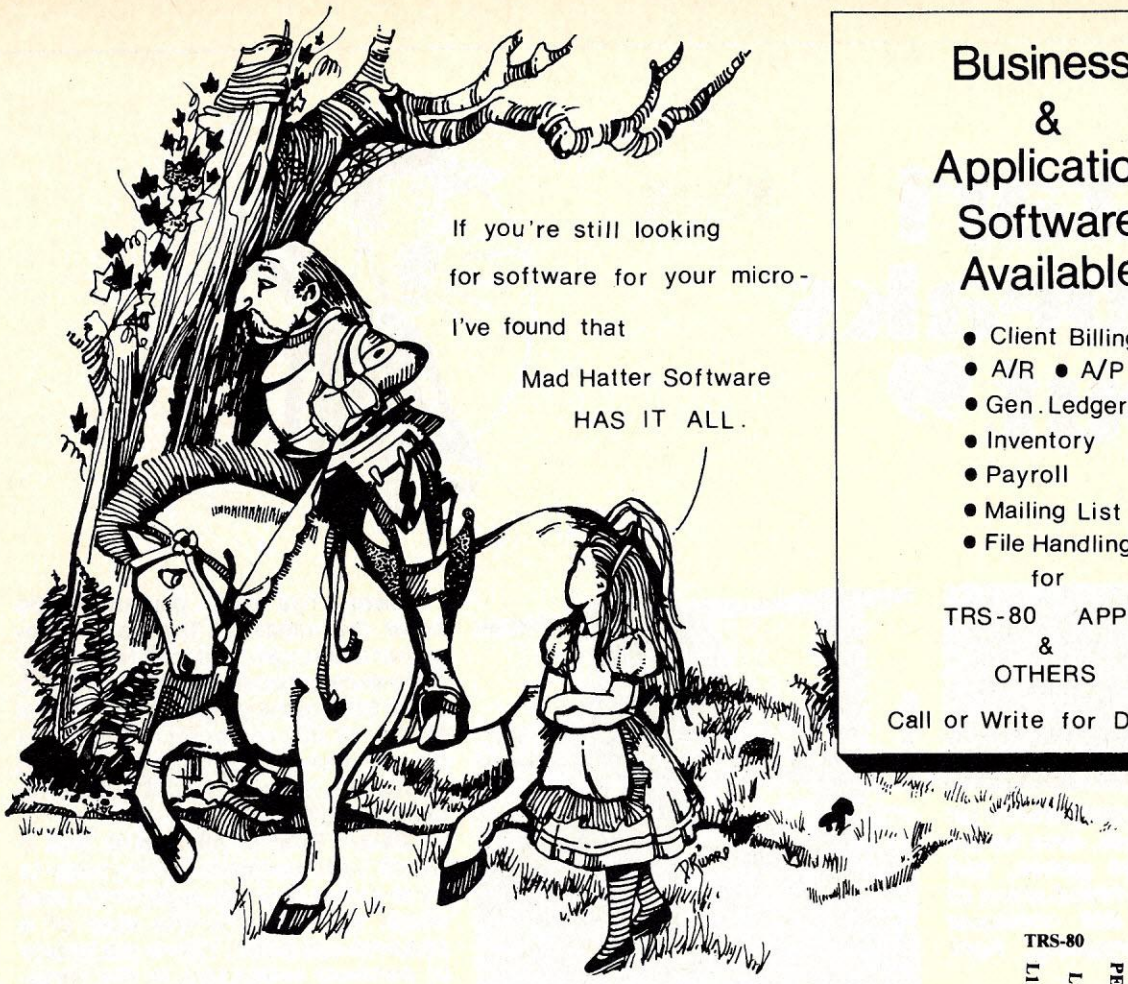

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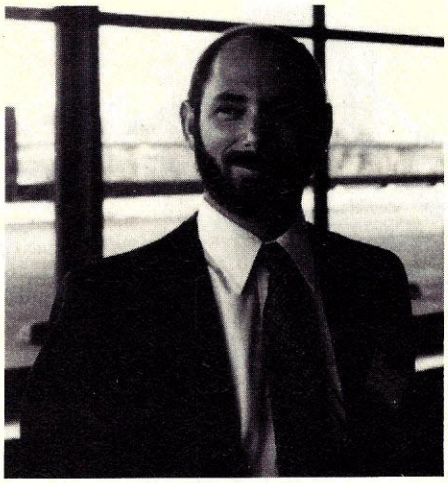
"Atari Speaks Out"

In the following interview, Dave Ahl of Creative Computing talks with Peter Rosenthal, marketing manager of personal computers for Atari. The date was June 4, 1969; the place, the Consumer Electronics Show in Chicago.

Dave: Atari is probably known for their home video games, even before that for coin-operated games, and most recently for the introduction of the Atari 400 and 800 computer system (Creative Computing, April 1979, pp 16, 62).

At the press conference held by Radio Shack recently, they introduced the TRS-80 Model II, a computer principally aimed at the small business market. Also in their marketing and advertising lately they have been mainly promoting the $1,000 version of the TRS-80 and more-or-less playing down the $600 system. What that seems to imply is that the home market is really not as big as perhaps they once thought. On the other hand, Atari is coming out with a product that has no immediate capabilities for the small business market. You are obviously betting mainly on the home market. How big do you think that market is?

Peter: First of all I would take issue with you on one point, which is that we have a system which doesn't have capabilities for the business market. We feel that the 800 computer definitely does have capabilities for the small business market if that market is defined as businesses in the order of 3 to 10 employees and the gross annual revenue under $500,000. We feel the 800, as we will demonstrate in the coming months, has some very immediate applications for that market. However, with respect to the home market I believe that Atari's experience in mass merchandise and consumer oriented video games gives



Peter Rosenthal

us a leading edge for approaching the mass market in the personal computer area. Starting with the design of these computers three years ago, from day 1 the approach was that this would be a mass marketable product that could be bought at an attractive price and could be designed for a consumer that had not necessarily had any prior computer experience. The design on both the 400 and 800 are modular in construction, UL and FCC approved and use ROM cartridges. This allows almost instantaneous program selection, very high speed action type games, and dynamic applications such as our calculator and assembly language cartridges. Although the machines are both shipped with the BASIC language there will be several other languages available for the machines. For example, assembly language is next, but beyond that we will have a graphics language suitable for in-school use and suitable for young people. We will probably also do a Pilot language, which is also suitable in schools and also for certain text-oriented applications.

Dave: You said, you think you know the needs of the home consumer market are. But isn't there a big difference between the willingness to buy a $169 game playing device and a $500 or $1,000 computer. What needs do you think you're going to satisfy to justify the laying out of $1,000 on a mass basis?

Peter: First of all, I think that it would be impossible for anybody to try to define a single application area which would justify the cost of a personal computer. I think the beauty of personal computers is the versatility and the fact they allow a variety of applications. One area that we see as having very high potential for in-home use is education; that's why with our introductory offering we are making available more than 15 educational programs, each one of which are 3½ hours in a format that has not been utilized previously in personal computers. It is a speaking format which also displays information on the screen. Other areas are personalized tutoring, where, say lessons in

Giving users access to data bases such as newspaper stories, news summaries, airline schedules, stock portfolio information, are all areas that are going to touch certain consumers.

mathematics or typing skills will be specifically geared to the individual user because the computer is able to access the rate of progress of the user. Another area is in money management such as budget planning and income tax preparation.

We don't see 1979 as being the peak year by any means in the personal computer industry. We see

Atari, con't...

this as a long term growth market which probably will begin to really burgeon in 1980 or 1981, but we are getting in early. We feel we have a product that is capable of change as the years progress without causing the consumer to have to substitute another product. Our products have been designed to be expandable to take advantage of the new technology as it comes along, especially in the 800 system which has a very modular construction. Even the operating system can readily be changed by the user.

A number of market research studies are predicting on the order of 600,000 to maybe 1,000,000 personal computers being manufactured in the United States in the years 1981 and 1982 and we would expect to have a significant share of that market.

Other areas which have high potential interest for us are in the areas of data base access using a modem, which we will probably have available early in 1980. Giving users access to data bases such as newspaper stories, news summaries, airline schedules, stock portfolio information, are all areas that are going to touch certain consumers.

We don't have a crystal ball to identify every single area of interest. But we are going to have a very broad software library and we are also encouraging independent software vendors to produce products for our machines. We're cooperating to the best of our abilities to put machines in their hands and to give information they need to also write software for our machine.

Dave: To date about half of the other computer manufacturers have encouraged outside software producers, while the others have discouraged third party software producers. I think one reason that the Brand X computer is successful or Brand Y is not successful is that a wide variety of software is available from sources other than the manufacturers. Since your software is available on ROM plug-in cartridges, are you going to make the manufacturing capabilities of those cartridges available, or do you expect third party vendors to have to stick to the tape programs which, as you pointed out earlier, have less capability and less appeal than a ROM module?

Peter: Another difficulty with tape is the speed of loading. Also the ease of duplication which I think is an issue with which every software manufacturer is seriously concerned. We're taking a position that we want to put out attractively-priced software on tape and we want to discourage illegal duplication. As you know it is illegal to duplicate somebody elses program even to pass it on to a friend. We intend to take a very strong position in that area to enforce our copyright protections.

With respect to making our ROM cartridge manufacturing capabilities available to outside vendors, we will probably do so under very strict licensing agreements, but the total nature of that agreement has not been formulated yet. One of the concerns in ROM manufacturing is the need to have a program which you feel will be very successful because of the number of ROMs that have to be made to make it be economically successful. This is one of our most critical areas of concern with regard to outside vendors. Will the programs be sufficiently popular that we can economically predict the sales of 20 to 30,000 programs which are what it requires for ROM technology to be economically feasible.

Dave: Apparently the approach that Texas Instruments is taking is to manufacture the ROMs for other vendors. So that while they are willing to have third party vendors market software on ROMs, they are actually keeping the manufacturing of those ROMs in-house.

"Good news, Ms. Callaway! Our new computer is friends with the IRS computer!" ©Creative Computing

Peter: In this area the significant difference between TI and ourselves is that we are not a vertically integrated company. We do not manufacture in-house ROM wafers, whereas TI does. When we design a ROM base program it is then submitted to outside vendors who actually physically produce the ROMs for us. We then do all the packaging to make the cartridges.

Dave: You mentioned that the market will perhaps reach the mass level in 1981 or 1982. How many units does that mean to you or how many units do you see going into the total market—½ million, a million a year?

Peter: In programmable video games, Atari has the largest market share. We currently have sold more than a million programmable Atari video computer systems. That is in the ball park of what we consider to be a mass market and we would look to a similar market penetration in the coming years in the personal computers. By no means do we expect to see that happen in 1979 or 1980. But I think by 1981 or 1982 we feel that it is not unrealistic to expect that kind of penetration. A number of market research studies are predicting on the order of 600,000 to maybe 1,000,000 personal computers being manufactured in the United States in the years 1981 and 1982 and we would expect to have a significant share of that market. Another figure that I've read that seems more incredible, but may be worth considering, is that by 1985 one projection suggests that 47 percent of American homes will own personal computers in one form or another. Whether they will be today what we call a personal computer or whether it will be the next generation, I think remains to be seen. That to me seems to be a slightly over optimistic prediction....

We believe that software is the key to the personal computer market.

We believe that software is the key to the personal computer market and we hope to play a very active role in software development for our machine but we want to see lots of other people getting in there. You can't make a record player that only plays one manufacturers record. We take a similar view of the software area.

Dave: Thank you for sharing your thoughts with the readers of Creative Computing. □

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The Third Computer Faire, which was held in Los Angeles, was somewhat of a disappointment in the attendance department. Jim Warren felt that Los Angeles was the reason, and the success of the 4th Faire, held in San Francisco, would seem to bear that out. The West Coast Computer Faires have come home to San Francisco...and here they'll stay. (At least, I sincerely hope so.)

There were some pleasant surprises at this show. I was expecting to see new software, which has been the case with most recent shows, but the 4th Faire had an abundance of **new hardware**. There were several new systems, from large and small manufacturers, and some interesting peripherals.

One of the new systems, of which I somehow failed to get a photo, was Southwest Technical Product's new 16-bit 6809 systems. Southwest was also demonstrating a new, low-cost Selectric interface they have recently developed. The interface allows the user to connect an unmodified IBM Model 50 Selectric typewriter to a 6800 or 6809 SS-50 bus. No solenoids or modifications to the typewriter. Sells for $59.95, assembled. (Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, TX 78216.)

Another significant new hardware development which escaped the camera was a TRS-80 running standard CP/M on 8" floppies. This magical feat has been accomplished through the genius of Howard Fullmer and Gene Nardi at Parasitic Engineering (1201 10th St., Berkeley, CA 94710). The "package" actually consists of two products; their Maxi-Disk, for $995, which is an 8" drive with controller and patches to the TRS-DOS. With that alone you can run TRS-DOS on large, 8" and/or 5" floppies (it allows you to have either, or both drives on-line at the same time). The second item is the "Shuffleboard." This board plugs into the Z-80 socket and moves the monitor ROM from lower memory to upper, and brings RAM into the lower. The incredible result is that you now have a TRS-80 which can run any CP/M software without re-assembling or modification. This package includes the board, the CP/M operating system on 8" diskette and all the manuals for $245. (By the way, if the new address for Parasitic Engineering looks familiar it's because it used to belong to George Morrow's Thinker Toys. I'm happy to report that George has outgrown himself, again, and had to move. The new address for Thinker Toys is 5221 Central Ave., Unit 9, Richmond, CA 94804.

Before I forget...cassettes of all of the talks given at the Faire are available for $6.00 (plus .70¢ shipping) from Adams Convention Reporting, 11 Galway, San Rafael, CA 94903. A wide range of interesting topics were covered...drop them a line for the list.

Our thanks to the incredible Faire staff for putting on a smooth and incredible show! □

Heath has gone and done it again. Their 2nd generation system is here! The new wh19 smart video terminal has its own Z80 microprocessor plus it has a very nice upper and lower case character set (with decenders). It sells for $675 in kit form and $995 assembled. The wh89 computer has all the features of the wh19 along with a built-in, single-density 5" disk drive and a central Z80 processor. The system comes with 16K of RAM which can be expanded internally up to 48K. Prices range from around $1500 to $2500, depending on options and whether kit or assembled version is purchased. H/S Data Systems, Schlumberger Products Corp., Hilltop Road, St. Joseph, MI 49085.

Computer Faire, con't...

Harry Garland, President of Cromemco, is proudly showing off their new Z-2H system. The "H" stands for hard disk and the 11 megabyte Winchester unit is shown partially pulled out, on the left, behind the front panel. The Z-2H has a fast 4 MHz Z80, the hard disk, 2 floppies, 64K RAM, RS-232 and printer interface, all for under $10,000 (which is not bad at all, once you start getting into hard disk systems). Cromemco, 280 Bernardo Ave., Mountain View, CA 94040.

At the MITA meeting Jim Warren (R) makes a point. Adam Osborne (L) stares down the crowd.

Yes, folks, it's Apples and Oranges! Freshly grown in Japan, the system on the right is being distributed by Advanced Computer Products, PO Box 17329, Irvine, CA 92713. It sells for 495 American dollars and the cabinet is a bright orange plastic (which matches the green keytops very nicely). Features include 64 x 64 color graphics, 16K RAM, cassette interface and a 7K ROM Basic. The microprocessor some brilliant committee decided to put in this unit is National Semiconductor's SC/MP. Cost effectiveness is the only reason I can see for making that selection. Considering the scant amount of software available for the SC/MP I hope the decision doesn't prove to be a disaster. (By the way, don't be confused...the Orange is not competition for the Apple!)

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The folks at Nestar Systems Inc. (430 Sherman Ave., Palo Alto, CA 94306) have developed a unique distributed processing system for the educational market. The system allows the use of TRS-80s, Apples, or PETs as smart terminals (complete with their own cassette and disk mass storage) for communicating with a "Queen" control computer which has single-sided 8" drives with 630 Kbytes storage or double-sided with 1.2 Mbytes. The system uses Microsoft BASIC and a future release will allow minimal-BASIC program transfers from one machine to another. It could also find application in laboratories, program development and small businesses. (We'll see if we can get an article on the system in the near future.)

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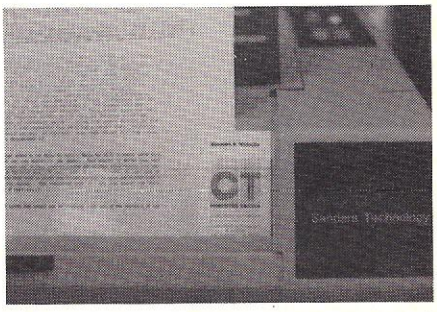
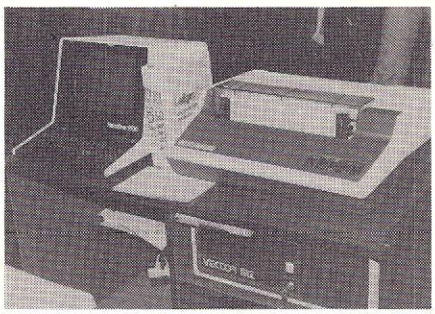
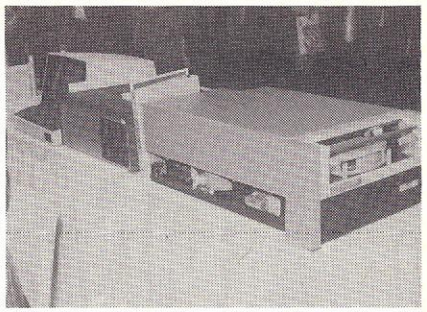
The Digital Group is one of the few companies still offering systems which are aimed at the homebrew hobbyist. The Z-BOARD1 is a good example of a complete CPU on a single board. It has a Z80, B/W or color graphics, calculator, time-of-day clock, D/A and A/D conversion circuits, 4 I/O ports and a monitor in ROM. It sells for $345 kit or $445 assembled. Sure looks like it would be ideal for teaching microprocessors in the classroom! Digital Group, PO Box 6528, Denver, CO 80206.



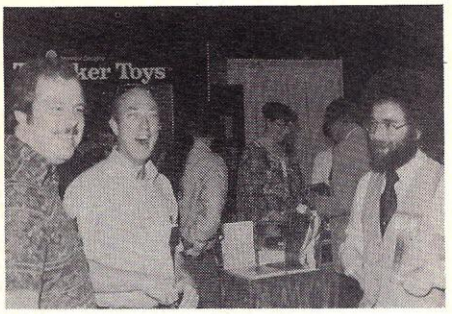
I tried to capture the incredible print quality of the Sanders Technology Media 12/7 printer in this photo (perhaps next time I should consider using a close-up lens?). The printer, which is dot-matrix, is being distributed by Computer TEXTile, 10960 Wilshire Blvd., Suite 1504, Los Angeles, CA 90021. The cost: a mere $3995.

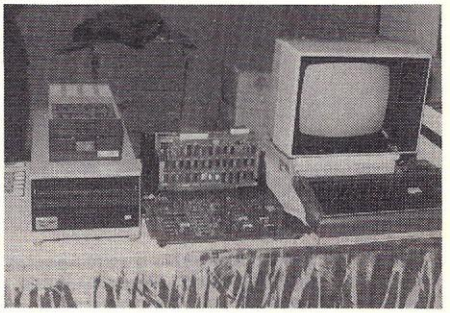




The folks at MicroAge have got **software!** Plus, they've got some impressive hardware to go with it. Their business packages include Ledger Plus (a fully integrated business package), AutoScribe (a word processing system for the North Star Horizon), Bookkeeper (a client write-up system for accounting firms), MoneyBelt (an accounting system for small to medium businesses) and TimeKeeper (a time management, accounts receivable and billing package for professional practices). Most of those packages are designed for the North Star, except for Ledger Plus, which will run on a Vector Graphic MZ system (as shown in the photo), Apple II, or TRS-80 with Micropolis drives. That huge disk drive in the right photo is a 40 megabyte Fujitsu M2201 interfaced to a Horizon (the same as having 200 double density North Star drives!). Drop 'em a line for more info: 1425 W. 12th Place, Tempe, AZ 85281.

Computer Faire, con't...





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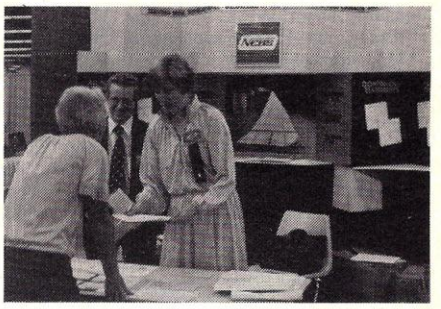
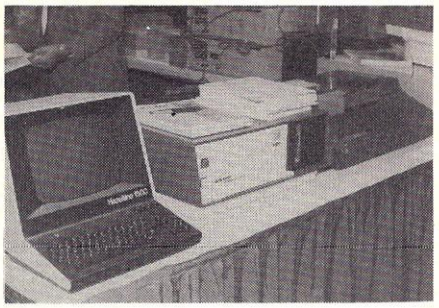
What do these three men have in common? Well, they're all crazy enough to try making a living in the world of personal computing. Don French, on the left, is the man behind FMG Corporation (CP/M, Cobol, Fortran and other software for the TRS-80). I have no idea who the man in the middle is, but it sure looks like he's having a good time. The distinguished gentleman on the right is Mark Garetz, who manufactures the S-100 bus adaptor/motherboard for the TRS-80 shown in the photo to the right (prices start at $185). He's also got a mini-version of the interface which sells for $115 in kit form. (HUH Electronics, 1429 Maple St., San Mateo, CA 94402). Mark was also instrumental in helping me dig out the facts on World Power Systems. They bought one of his interfaces...and chances are if anyone got delivery of an S-100 adaptor from World Power, it was Mark's.



Dan Flystra, of Personal Software (592 Weddell Dr., Sunnyvale, CA 94086), is shown demonstrating their latest product, a financial management package for the home and small business. This piece of software is so flexible and versatile they felt the only way to introduce it was with live demonstrations to dealers. (We're definitely going to get an in-depth review of it so you can fully appreciate all of its capabilities.) Just to give you an example of the versatility (and utility), Dan is displaying the entries for one month on the screen, and the other 11 months of the year are also in memory...to be called upon with a horizontal, wrap-around scrolling technique. If, for example, he was dealing with sales projections in a small company he could enter some of the parameters for that month then very quickly go to a future month and see what affect those figures would have. (I really can't do it justice here...we'll have more in an upcoming issue.)



JADE Computer Systems (4901 W. Rosecrans, Hawthorne, CA 90250) was showing off their new system, the "Piggy." (The idea behind "Piggy" was to have a down-to-earth name for a sophisticated computer system.) It comes in 5 colors and is available in a variety of configurations, including an Electric Pencil word processing system. Prices start at $475, for a main frame & power supply, up to $5795 for the Word Processor with a Qume printer.

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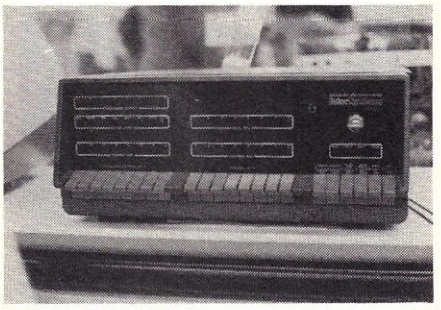
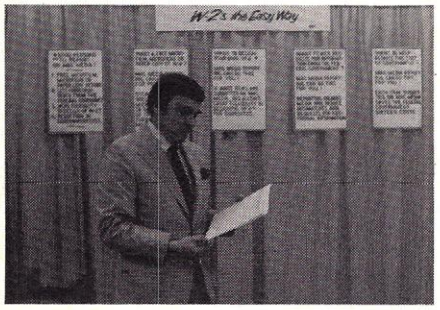
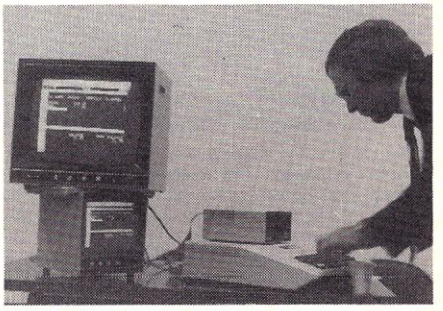


InterSystems, a division of Ithaca Audio, introduced their new DPS-1 at the Faire. If you think it looks like a mini-computer, then good... that's what they were trying to make it look like. The cabinet contains a 20-slot S-100 system working with one of the most sophisticated front panels I've seen in some time. Drop them a line for further information and prices: PO Box 91, Ithaca, NY 14850. (They also have new high-density graphics and analog I/O boards.)



Jere McEvilly, from the Department of Health, Education & Welfare, was handing out brochures on how to submit wage and tax information to the federal government on diskettes. You can get a booklet describing the format and procedure from U.S. Dept. of Health, Education & Welfare, Social Security Administration. It's HEW Publication No. (SSA) 78-10169, TIB-4c. (This is not for income tax...but for reporting FICA, W2 and other wage information.)



One of the most expensive items for a small business which has just gone the computer route is getting custom-printed, continuous forms: invoices, checks, statements, etc. I try to keep my enthusiasm in check, but this company (New England Business Service - NEBS) really blew me away with their prices and delivery. For example, you can order as few as 250 single payroll checks, with pay statements, imprinted with your company name for $24.95! 500 of the duplicate All-Purpose checks sells for $39.95 (6,000 checks would cost you $230...about $0.04 apiece). They even provide the customer with a programming guide. Delivery? They try for 6 working days ARO. NEBS, Inc., North Main St., Groton, MA 01450.

Dr. Robert Suding, President of the Digital Group contemplates some output.

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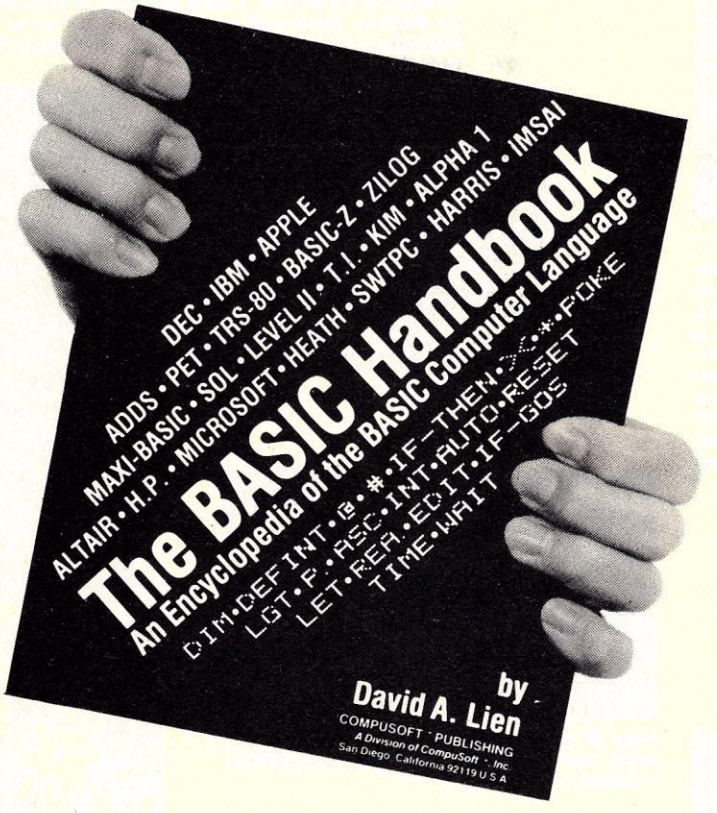
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CIRCLE 114 ON READER SERVICE CARD

Computer Faire, con't...

Looks like a terminal at first glance...but it isn't. It's the Omega 9000, a new entry into the personal computer field from Omega Micro Systems, 9710 Cozycroft Ave., Chatsworth, CA 91311. The system is 6502-based and has a high-resolution monitor for graphics, Microsoft BASIC, 4K RAM (expandable to 32K internally), Kansas City cassette and upper and lower case keyboard...for less than $1000 (which probably means $995). They've also got quite a lineup of educational, personal, game and business software for the system.

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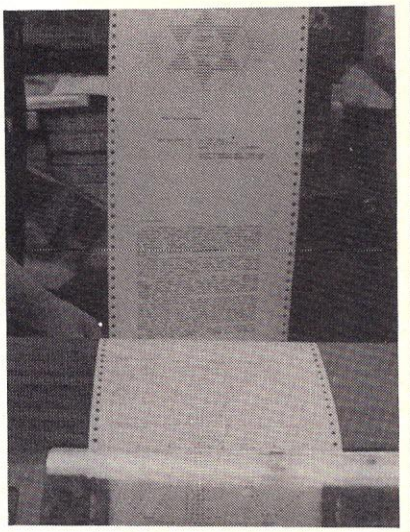
Vector Graphic has a new digitizer board to go with their high-resolution graphics board. The digitized image on the monitor (yours truly taking the photo) is an example of the high-resolution available from the combination. The horizontal resolution is about 700 points per line and the vertical is about 480 lines per image. Cost is approximately $175. Vector Graphic, Inc., 31364 Via Colinas, Westlake Village, CA 91361.

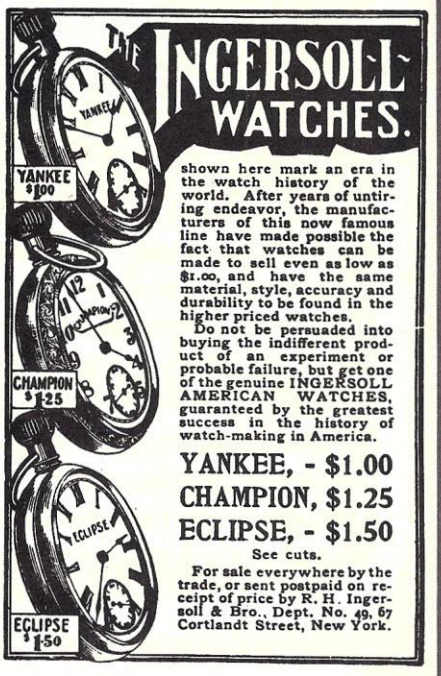
Photo 18 and 19.

Okay, you astrology buffs, this is the one you've been waiting for! SOLSIGN is a new program from Processor Technology which creates a twelve page natal horoscope with complete interpretation based on time and place of birth. It must be good...it took three years to develop (in Fortran, even) and costs $200. Runs on a Sol with PT-DOS. Processor Technology, 7100 Johnson Industrial Dr., Pleasanton, CA 94566.



View of one aisle of downstairs exhibit area. Atari booth (to the left) was perpetually mobbed.

John Craig reports on the World Power Systems swindle at the MITA meeting.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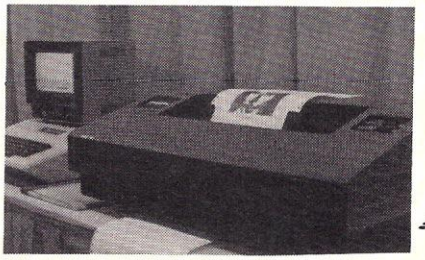

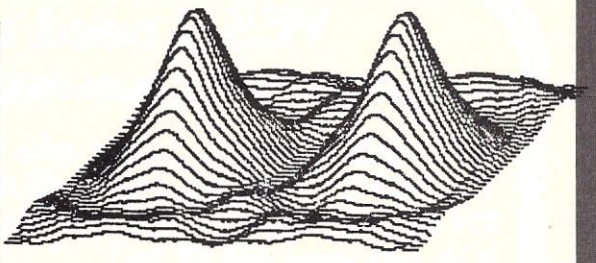

DOUBLE BESSEL FUNCTION

It's graphics time! The high-resolution graphics of the Apple II has been introduced to the high-resolution graphics of the Malibu 165 printer...and they like each other. Malibu has developed an interface board which allows the Apple to use the Malibu for regular printer applications (including word processing, with its enhanced character set) but, most importantly, unlimited graphics - a sample of which is shown to the right. Malibu Design Group, 8900 Eton Ave., Suite G, Canoga Park, CA 91304.

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Donald D. Spencer. Enjoy the challenge of competition with your personal computer. Amuse yourself with such computer games and puzzles as 3-D Tic-Tac-Toe, Roulette, Baccarat, and more. Includes rules of each game, how each game works, illustrations and the output produced by each program. The last chapter contains 26 games for reader solution. 176 pp. $7.95 [10D]

Chess and Computers

David Levy. This book is loaded with chess games—computer versus computer and computer versus human. Settle down with this book, set up your chess board, and play the games. As with any good chess book, half the enjoyment is found in playing along, duplicating the moves and reading the authors comments. 145 pp. $8.95 [10C]

What to Do After You Hit Return

Another collection of games and simulations—all in BASIC—including number guessing games, word games, hide-and-seek games, pattern games, board games, business and social science simulations and science fiction games. Large format. 158 pp. **$10.95** [8A].

Fun With Computers and Basic

Donald D. Spencer. Mathematical recreations and games are an excellent medium for teaching computer programming. The reader learns the BASIC programming language during the process of learning to program fun type problems. The book introduces the reader to flowcharting, and the BASIC programming language. Includes many BASIC programs, cartoons, and drawings. Written specifically for use by junior high school students. 96 pp. **$7.95** [10F]

Fun & Games With the Computer

Ted Sage. "This book is designed as a text for a one-semester course in computer programming using the BASIC language. The programs used as illustrations and exercises are games rather than mathematical algorithms, in order to make the book appealing and accessible to more students. The text is well written, with many excellent sample programs. Highly recommended."—*The Mathematics Teacher.* 351 pp. **$8.95** [8B].

Game Playing With Computers (Revised 2nd Edition)

Donald D. Spencer. Now you can sharpen programming skills through a relaxed and radically different approach. Including 70 games, puzzles, and mathematical recreations for a digital computer. It's fully illustrated and includes more than 25 game-playing programs in FORTRAN or BASIC, complete with descriptions, flowcharts, and output. Brand-new "how to" information for applying mathematical concepts to game playing with a computer. 320 pp. $16.95 [10G]

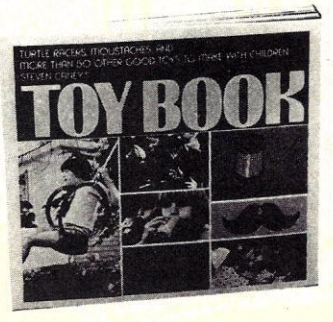
Other Games & Activities

The Way To Play

The newest, most comprehensive encyclopedia of games in the world. Complete rules for over 2000 games and indoor pastimes including race board games, strategic board games, tile games, card games, solitaire games, dice games, table games, casino and gambling games, games of chance and many more. Over 5000 drawings and diagrams in color. The perfect sourcebook for the computer game author. 320 pp. $7.95. [10H]

The I Hate Mathematics Book

Marilyn Burns. This book is for nonbelievers of all ages, but especially for kids who are convinced that mathematics is (1) impossible, (2) only for smart kids, and (3) no fun anyhow. This book shows that mathematics is nothing more (nor less) than a way of looking at the world and is not to be confused with arithmetic. In this book you'll find several hundred mathematical events, gags, magic tricks, and experiments to prove it. 128 pp. $3.95 [11F]



Toybook

Steven Caney. "More than 50 toys and projects have been chosen with imagination and care to provide a high ratio of satisfaction and fun in return for effort invested." —*Parents' Magazine.* It is "... a must for kids and anybody else interested in conjuring up delightful playthings out of odds and ends and scraps of stuff around the house." —*Whole Earth Epilog.* Packed with illustrations, photos, and step-by-step instructions. 176 pp. $3.95 [10J]

Star Games

Razzi, Brightfield and Looney. For *Star Trek* and *Star Wars* fans, here's a book that invites you to "join the Space Force for the greatest galactic battle of your life!" A game book, not a puzzle book, it challenges you to crack space-age binary codes and help your friends escape from the krakon's clutches. $6.95. [10K]

Cross-Sums

Maltby & Fulbrook. The answers are numbers! Vertical columns must total the same as horizontal rows. It's a new puzzle game — constructed by Richard Maltby, Jr., master puzzlemaker for *Harper's* and *New York* Magazines. 30 puzzles including Nursery Rhymes, Children's Hour, Golf, Movies, Famous Dates, and more. 108 pp. $1.95 [10L]

Geometric Cross-Sums

Maltby & Fulbrook. Another puzzle game. This one has 30 puzzles ranging in difficulty from easy to fiendish. Each diagram takes a special shape — Triangles Fun, The Magic Hexagon, Shapes Within Shapes, Literature in 3-D., and more! 108 pp. $1.95 [10M]

Merlin's Puzzlers

Charles Barry Townsend. "Puzzle books are nothing new, and neither are the puzzles in them. But what sets *Merlin's Puzzlers* apart from the crowd is the style and imagination with which the material is presented. In Volume 1 he calls upon Sherlock Holmes to pose the problems to Watson, and the Mad Hatter and Humpty Dumpty (among others) to confuse and confound "Alice in Puzzleland." Richly illustrated with old woodcuts, lithos, prints, and playbills — *Games Magazine.* Each volume 128 pp. large format. Two-volume set $7.50. [ ]

To Order

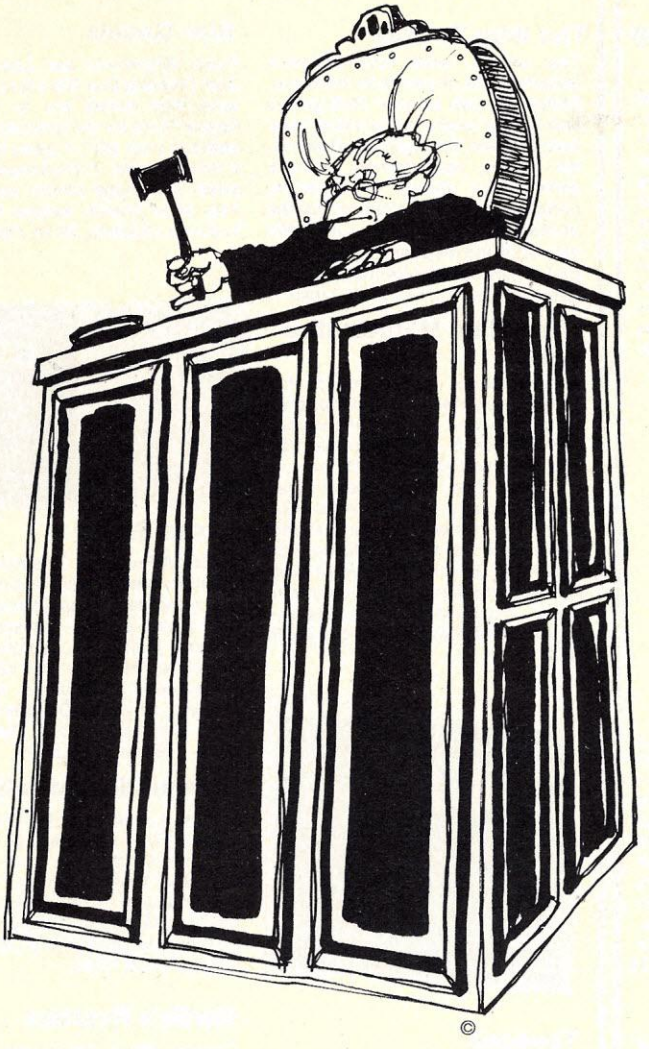
Use the bound-in order form or send your check for books plus $2.00 shipping and handling per order (Foreign: $1.25 per book) to Creative Computing, P.O. Box 789-M, Morristown, NJ 07960. NJ residents add 5% sales tax. Visa or MasterCharge are acceptable also. For faster service, call in your bank card order toll free to:

800-631-8112

(in NJ call 201 540-0445)

The Law And Your Computer

Harold Gluck, Ph.D.



The decisions in two recent court cases might very well have an affect on you and your computer system. There are a number of ways you could lose your computer and the following two case studies are examples of situations about which you should be aware and avoid.

The Insurance Game

The first case concerns an insurance policy. We start with an unpleasant situation that every owner of a computer would like to avoid. Namely, coming home from an enjoyable evening at the movies and finding that the house has been burglarized! And, what is missing? Only the computer and all its accessories.

Insurance will not return the stolen items to you but it will give you monetary compensation. With the money received, you should be able to replace a great part or even all of the items stolen. If you use your computer in a business or profession, the headache with the insurance money is softened.

In one particular case the appellate court held that a material misrepresentation by the plaintiff in regard to the value of his items VOIDED his insurance policy covering theft! The insurance company issues a policy to the plaintiff. A theft took place and he asked the insurance company to reimburse him for the loss. Sounds simple, doesn't it? However, the insurance company refused to pay the claim. It said that the policy was void because of a material misrepresentation by the plaintiff in the proposal for insurance. The insurance company required a proposal to be submitted to it, containing among other things, a specific statement regarding the inventory. This statement was to show when the last inventory had been taken. And also the maximum value of the stock during the preceding twelve months. The premium charged was based on the statements contained in the proposal. In this case, the misrepresentation of the plaintiff was that he claimed a dollar value on his last inventory which was less than the true value. The plaintiff conceded this error. In the lower court, the plaintiff's motion for summary judgment against the insurance company was granted.

An appeal was made by the insurance company and in the higher court the verdict of the lower court was set aside. Actually, the verdict was reversed. The motion of the insurance company to have the complaint of the plaintiff dismissed was granted. The higher court said that according to the insurance law, recovery under a contract of insurance may be defeated if a material misrepresentation is made to the insurer. What is a material misrepresentation under the law?

The law holds that "a misrepresentation is material if the insurer, knowing the true facts, would have refused to make the contract." The court then pointed out that the insurance company would not have issued the insurance policy if it had known the true value of the inventory. Why? Because the premium would have been higher. The court further pointed out that it would have been illegal for the insurance company to enter into such an insurance contract charging the lower rate.

There are only two reasons why a person who wanted an insurance policy to cover theft would understate the value of his inventory. One reason comes under the heading of "deliberate fraud." No such charge was made in this specific case. Such a deliberate fraud would at once vitiate any theft policy. The other reason comes under the heading of "carelessness, indifference, or being rushed. Even thinking that a correct value of the inventory wasn't too important" (i.e., a guess would do the trick).

Not only did the plaintiff lose his case, but the insurance company was also awarded costs and disbursements for the appeal. In view of this decision, it means you want to protect yourself to the utmost. Hence, it's very important that you keep

Dr. Harold Gluck, 2939 Grand Concourse, Bronx, NY 10468.

accurate records and receipts for your computer and all accessories that are connected with it.

Let's assume that your computer system is in your home. What kind of a burglary policy do you have? Get it out and read it now. Does it also cover that computer? The company may claim that the computer is part of your business which may mean a separate policy for the computer.

If you are in doubt as to the exact meaning of a given clause in your policy then call your state insurance commission. Tell them the problem. They may ask you to write it down and mail it to them. What you want in return is a written statement which explains the matter to you. You can also check with your lawyer. And finally, check with the main office of your insurance company. You want to be certain that you are actually covered in case of a burglary.

After you have read this, I can imagine that you're asking the question: "Couldn't the insurance company have pro-rated the loss?" The answer is a big NO and that is what the court held: No recovery at all.

It is a good idea to keep your insurance records, or copies of them in your safe deposit vault. Don't accept an insurance broker making a statement such as, "In my opinion, I would tend to say you are fully insured." That is an equivocal reply. In a similar situation, I asked for a definite no or yes. Since they refused to give it, my statement to my client was, "I doubt if you are insured under the facts presented."

The Liability Game

The second case concerns a situation where you take your computer to be fixed. It may be to the place where you purchased it or to an electronic specialist who fixes computers.

Your story is simple: "It is my fault. I left the room and my 10 year old got to work on it. He put it out of commission. Check it out for me and repair it."

You come back a week later **and he can't find your computer!**

"I fixed it and it works perfectly," he tells you, "but it must have been mislaid. I'll have it for you tomorrow."

Tomorrow, he can't find it nor the day after. Then you take a good look at your receipt. For the first time you notice the print that reads: "Responsibility limited to $50.00." And, you paid $2500.00 for your computer. If you sued, would you recover?

The receipt and the contract of repair were cleverly constructed. The customer was told to place a check in the box to show that he understood the $50 limitation. When he came for his item, it had apparently been lost. Now, he wants the value of the item as compensation.

In this case, the plaintiff contends that he never agreed to this limitation. Therefore, there was lack of contractual effect, and further, such a limitation is valid only upon the strictess of scrutiny.

The court looks up the law on the subject and finds it to be: "The parties to a bailment may, by special contract, diminish the liability of the bailee, or limit the amount of the bailee's liability to the agreed valuation of the bailed property, the principle being that the bailee may impose whatever terms he chooses, if he gives the bailor notice that there are special terms and the means of knowing what they are, and if the bailor chooses to make the bailment, he is bound by them." The plaintiff lost in this case. The court concluded: "The plaintiff, having signed the agreement, is bound by its terms. If he was able to read the document, not to have read it was gross negligence; if however, he could not read it, not to procure it to be read was equally negligent. In either case the writing binds him."

In light of this decision, you certainly want to protect yourself. You worked hard for the money to get that computer. To lose it so easily doesn't make much sense. Here are some suggestions to follow:

1. Read any repair contract handed to you. Read it carefully. Notice if it has a limitation of responsibility on it.
2. Read very carefully the statements on your claim stub. Note also if it has such a limitation of responsibility on it.
3. If there is a limitation, then make arrangements with the manager or owner to have it deleted. In doing so, make certain he's aware of the value of your system. If he refuses to do this and you leave the computer to be fixed, you are doing it with your eyes wide open. Or, you can leave the store to look for another place.
4. You can contact your Chamber of Commerce and other consumer organizations in the community for further advice on this subject.

One dealer who knew I was writing this article informed me: "I carry a lot of insurance and I'm covered in case the item to be repaired turns up missing. There is no limitation of liability on my claim checks." □

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CIRCLE 141 ON READER SERVICE CARD

Who's Reading creative computing These Days?

If you've ever filled out the questionnaire on the reader service card bound in the back of the magazine and wondered what we do with information about your age, occupation, computing habits, etc., your curiosity is about to be satisfied. Rest assured that we do not furnish this information to the IRS, FBI or CIA. We use it to improve the quality of the magazine, to tailor our content according to our readers' preferences and circumstances and to interest advertisers in supporting us. With this article we are continuing a third use for the data accumulated from the questionnaires: to introduce **Creative Computing** readers to other **Creative Computing** readers. You all have a great deal in common aside from your subscriptions to this magazine, and should be as interesting to each other as you are to us. Bear in mind however that these data pertain to those readers who have mailed in reader service cards; and, therefore, may not be representative of the total readership of **Creative Computing**.

Although the reader service card has carried various questionnaires since its inception in March 1978, the most interesting data is probably th most recent. The Sep/Oct, and Nov/Dec 1978 reader service cards, for example, contained questions designed to find out what kind of programs you'd like us to publish (Reader Service Card 1).

1. In addition to BASIC, which computer language would you prefer that Creative Computing use for publication of computer programs? (check *one* only).

   a ☐ APL d ☐ PL/I g ☐ COBOL
   b ☐ FORTRAN e ☐ PASCAL h ☐ RPG
   c ☐ ALGOL f ☐ ASSEMBLER i ☐ SNOBOL

2. In which types of programs are you most interested? (check all that apply.)

   1 ☐ Simulations, complex games, AI, etc.
   2 ☐ Short, imaginative games.
   3 ☐ Personal applications programs (personal Finance, record keeping, etc.)
   4 ☐ CAI programs
   5 ☐ Business programs (mailing lists, accounts payable, etc.)

3. What's the longest program that you will use? (check one only)

   a ☐ under 50 lines d ☐ under 500 lines
   b ☐ under 100 lines e ☐ over 500 lines
   c ☐ under 250 lines

4. In Future issues would you like to see the pages of Creative Computing devoted to: (check one only.)

   a ☐ more programs b ☐ same percentage of programs
   c ☐ fewer programs

Reader Service Card 1

Question 1, concerning computer language preference in addition to Basic, elicited overwhelming support for Fortran, Assembly language and Pascal. (Figure 1). The popularity of Fortran is probably attributable to its widespread use in industry (how many of you are playing Eliza and Adventure during office hours?), although there are a few microcomputer versions available.

The support for Pascal is impressive since we doubt that 15% of you actually have Pascal up and running on your machines right now. Be that as it may, we will try to publish some good Pascal programs in the future; especially since Pascal is more structured and people-oriented than Basic. But ultimately the nature of the software we publish depends on the languages that our readers are actually using, and our readers are generally using Basic. However, the availability of UCSD Pascal for CP/M, North Star Horizon and Apple II, as well as the existence of a dedicated Pascal machine, the Western Digital Microengine, may change things.

Although Assembly Language received a large share of the vote, everyone probably wants programs for their specific processor or operating system.

We had suspected that most of our readers would prefer short, uncomplicated programs that can be entered and run in a single session at the computer. But reader feedback on programs like Super Star Trek, Eliza, Oregon Trail, and Euclid compounded with the data from questions 2, 3 and 4 proved our initial impressions incorrect and command our respect for your ambition (Figures 2 and 3).

But tell us, how do you fit 500 line programs in your 4K Level-I TRS-80s? That's the machine most of you own, according to data accumulated from the reader service card survey conducted in the January, February and March 1979 issues (Reader Service Card 2 and Figure 4).

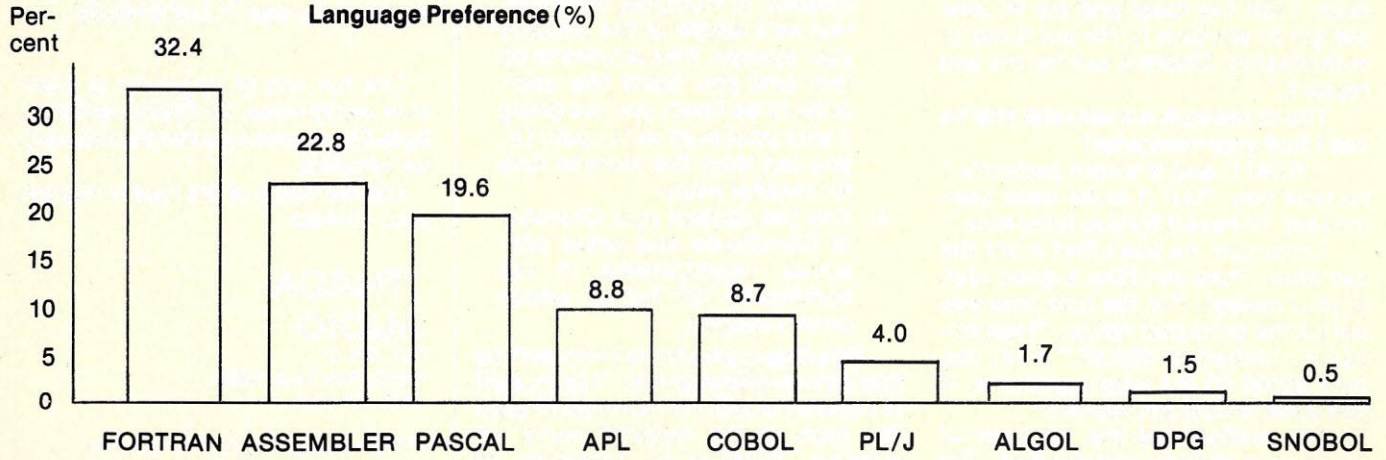


Figure 1

THE SEARCH FOR A SMALL COMPUTER SYSTEM STARTS HERE

It's the 3rd Annual National Small Computer Show

New York Coliseum, August 23-26, 1979

presenting the state-of-the-art showcase for micro-and mini-systems technology and software. Here you can survey virtually all makes and models of small computers, whether your interest runs to a no-nonsense micro priced in the hundreds of dollars or a powerful mini costing $20,000 or more. They're all here.

The world of small computers is quite large, extending to business and professional offices, scientific research, medicine and bionics, education, the home and hobbyist, therapeutic applications for the handicapped, design and engineering. A full selection of lectures is presented to provide a grasp of small systems technology, so that you know what to consider when buying a computer or word processor. It's the first step in discovering what a system can really do for you!

NSCS lectures include sessions on system selection, computer languages, word processing functions, artificial intelligence, software applications, and a dozen more topics for people of all interests.

Plan now to attend. There will be about 30,000 square feet of exhibits, and more than 40 hours of lectures from which to choose. Registration fee is only $5.00 per day, including lectures.

LECTURES: (Program subject to change)

Thursday, August 23

- **1 p.m.** The Peril of Becoming a Machine-Oriented Business User
- **1 p.m.** Introduction to Small Business Systems
- **2 p.m.** Selecting a Word Processing System
- **2 p.m.** Distributed Data Processing
- **3 p.m.** Accounts Receivable/General Ledger/Accounts Payable
- **3 p.m.** Is There a Computer in Your Educational Future
- **4 p.m.** Mailing Lists: Load, Time and Cost
- **4 p.m.** Word Processing Systems in the Law Office
- **5 p.m.** Basic BASIC
- **5 p.m.** Achieving Quality Control in Word Processing

Friday, August 24

- **1 p.m.** The Peril of Becoming a Machine-Oriented Business User
- **1 p.m.** Introduction to Small Business Users
- **2 p.m.** Selecting a Word Processing System
- **2 p.m.** Distributed Data Processing
- **3 p.m.** Unassigned at press time
- **3 p.m.** How to Write a User-Oriented Program
- **4 p.m.** Efficient Expansion of a Small System
- **4 p.m.** Investment Analysis
- **5 p.m.** Accounts Receivable/General Ledger/Accounts Payable
- **5 p.m.** Exploiting the Apple/Dow Jones Computer Link

Saturday, August 25

- **11 a.m.** Introduction to Personal Computing
- **11 a.m.** Unassigned at press time
- **12 p.m.** Computer Music Update
- **12 p.m.** Unassigned at press time
- **1 p.m.** Introduction to PASCAL
- **1 p.m.** Computer Art Forms
- **2 p.m.** Household Applications
- **2 p.m.** Artificial Intelligence
- **3 p.m.** How to Write a User-Oriented Program
- **3 p.m.** Investment Analysis
- **4 p.m.** Basic BASIC
- **4 p.m.** Unassigned at press time

Sunday, August 26

- **11 a.m.** Introduction to Personal Computing
- **11 a.m.** Computer Music Update
- **12 p.m.** Household Applications
- **12 p.m.** Unassigned at press time
- **1 p.m.** Efficient Expansion of a Small System
- **1 p.m.** Computer Art Forms
- **2 p.m.** Unassigned at press time
- **2 p.m.** Unassigned at press time
- **3 p.m.** Microcomputers for the Handicapped: Update
- **3 p.m.** Exploiting the Apple/Dow Jones Computer Link
- **4 p.m.** Mailing Lists: Load, Time and Cost
- **4 p.m.** Introduction to PASCAL

REGISTRATION FOR AMERICA'S BIGGEST SMALL COMPUTER SHOW

Please register me for the 3rd Annual National Small Computer Show, Aug. 23-26, 1979.

NAME _____ BUSINESS TITLE (If Any) _____

COMPANY (If Any) _____ TELEPHONE _____

ADDRESS _____

_____ ZIP _____

(Check main interest)

- ☐ Banking/Insurance
- ☐ Business office
- ☐ Communications
- ☐ Educational
- ☐ Government
- ☐ Hobby
- ☐ Industrial/Manufacturing
- ☐ Military
- ☐ Professional
- ☐ Stock Brokerage
- ☐ Transportation
- ☐ Utility
- ☐ Wholesale/Retail
- ☐ Other _____

(Check main job function)

- ☐ Accountant
- ☐ Administrator (Business)
- ☐ Architect/Builder
- ☐ Art Director
- ☐ Banker
- ☐ Computer technician
- ☐ Consultant
- ☐ Controller
- ☐ Engineer
- ☐ Industrial Designer
- ☐ Lawyer/law office mgr.
- ☐ Marketing manager
- ☐ Medical doctor
- ☐ Medical technician
- ☐ Office manager
- ☐ Programmer
- ☐ Public Servant
- ☐ Research/Development
- ☐ Teacher
- ☐ DP manager
- ☐ WP manager
- ☐ WP operator
- ☐ Stock Broker
- ☐ Systems Analyst
- ☐ Student
- ☐ Other _____

☐ ONE DAY $5 ☐ TWO DAYS $10
☐ THREE DAYS $15 ☐ FOUR DAYS $20

Mail with payment of $5 for each day you wish to attend. Use one form per person. Registration badge will be sent by mail in early August. Check or money order only.

Mail prior to Aug. 10 to:
National Small Computer Show,
110 Charlotte Place,
Englewood Cliffs, N.J. 07632.

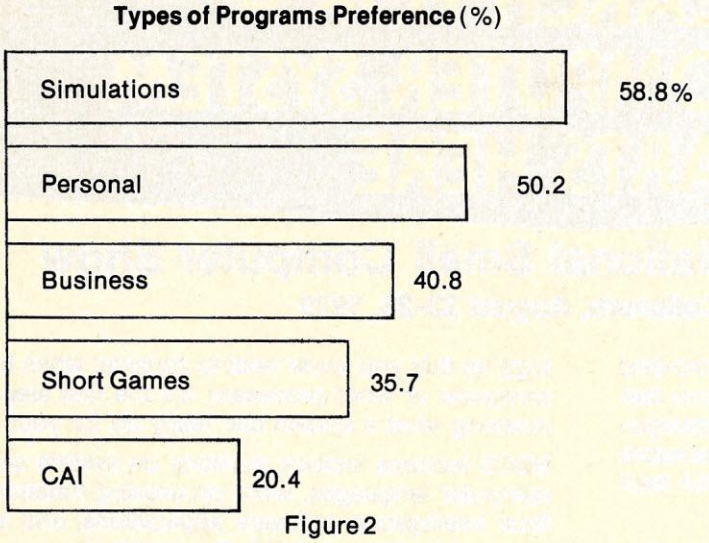


Figure 2

Please take a moment to tell us a little more about your interests.

1. Other magazines I read (check all that apply):
   a ☐ Byte
   b ☐ Computerworld
   c ☐ Interface Age
   d ☐ Kilobaud
   e ☐ Personal Computing

2. What, if any, personal computer do you have (check only one):
   a ☐ TRS-80
   b ☐ Apple II
   c ☐ PET
   d ☐ Sol
   e ☐ Sorcerer
   f ☐ Altair
   g ☐ IMSAI
   h ☐ SWTPC
   i ☐ Heathkit
   j ☐ OSI Challenger
   k ☐ Horizon
   l ☐ Cromemco
   m ☐ Xitan
   n ☐ Kim
   o ☐ RCA COSMAC
   p ☐ Other Assembled
   q ☐ Homebrew
   r ☐ No System at Present

3. What level of education did you complete (check only one):
   a ☐ Current student (any level)
   b ☐ Some High School
   c ☐ High School Graduate
   d ☐ Some College
   e ☐ 2-year degree
   f ☐ 4-year degree
   g ☐ Masters degree
   h ☐ PhD or EdD

4. Your sex: a ☐ Male b ☐ Female

Reader Service Card 2

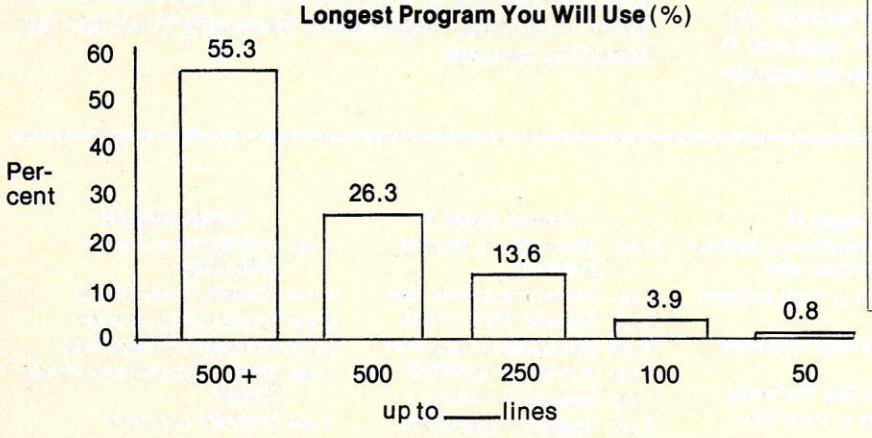


Figure 3

Please answer each question by checking box.

1. Your age
   a ☐ under 20
   b ☐ 20-29
   c ☐ 30-39
   d ☐ 40-49
   e ☐ 50-59
   f ☐ 60 plus

2. What is your job title?
   a ☐ President/Owner/Director/Chairman
   b ☐ Systems Analyst/Software Designer/Programmer
   c ☐ Engineer/Technical Staff/Mathematician
   d ☐ Consultant
   e ☐ Student (full time)
   f ☐ Faculty
   g ☐ Student (part-time)

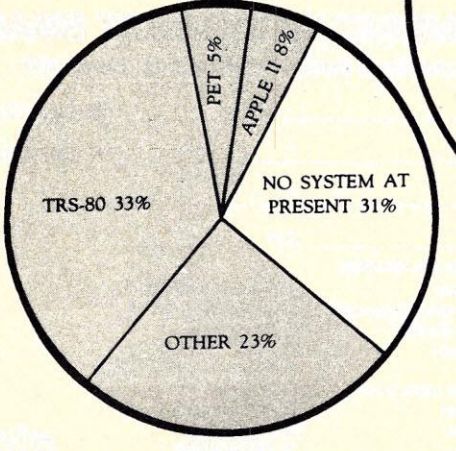
3. What computer-related products would you recommend, select and/or purchase for your business?
   a ☐ Medium/Large computer
   b ☐ Minicomputer
   c ☐ Microcomputer
   d ☐ CRT Terminal
   e ☐ Teleprinter
   f ☐ Peripherals
   g ☐ Books & Publications

4. How Many people read your copy of Creative Computing?
   a ☐ One b ☐ Two c ☐ Three d ☐ More

Reader Service Card 3

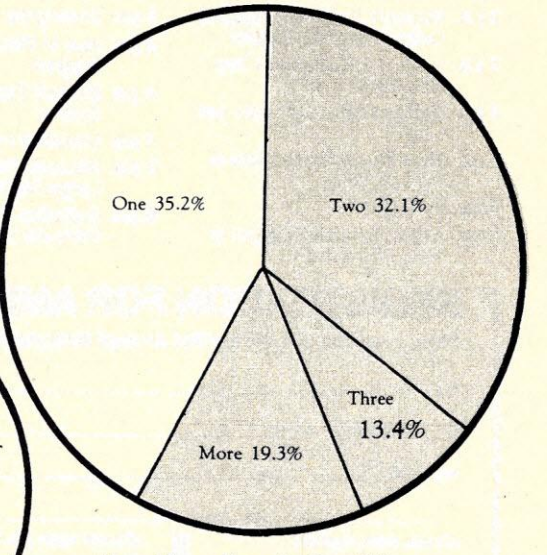
The answers to the other questions on the Jan-Mar cards, and the data from the April, May and June cards (Reader Service Card 3) show that **Creative Computing**'s circulation, while sorely lacking a female element, is drawn from an experienced, intelligent group. (Figures 5-8). We are proud to be able to maintain your interest and grateful for your input to these surveys.

Finally, we thank you for being so generous in lending Creative Computing to your friends (Figure 9). But if you find that your copies aren't finding their way back to your library, try handing the would-be borrower the bound-in subscription card next time. ☐



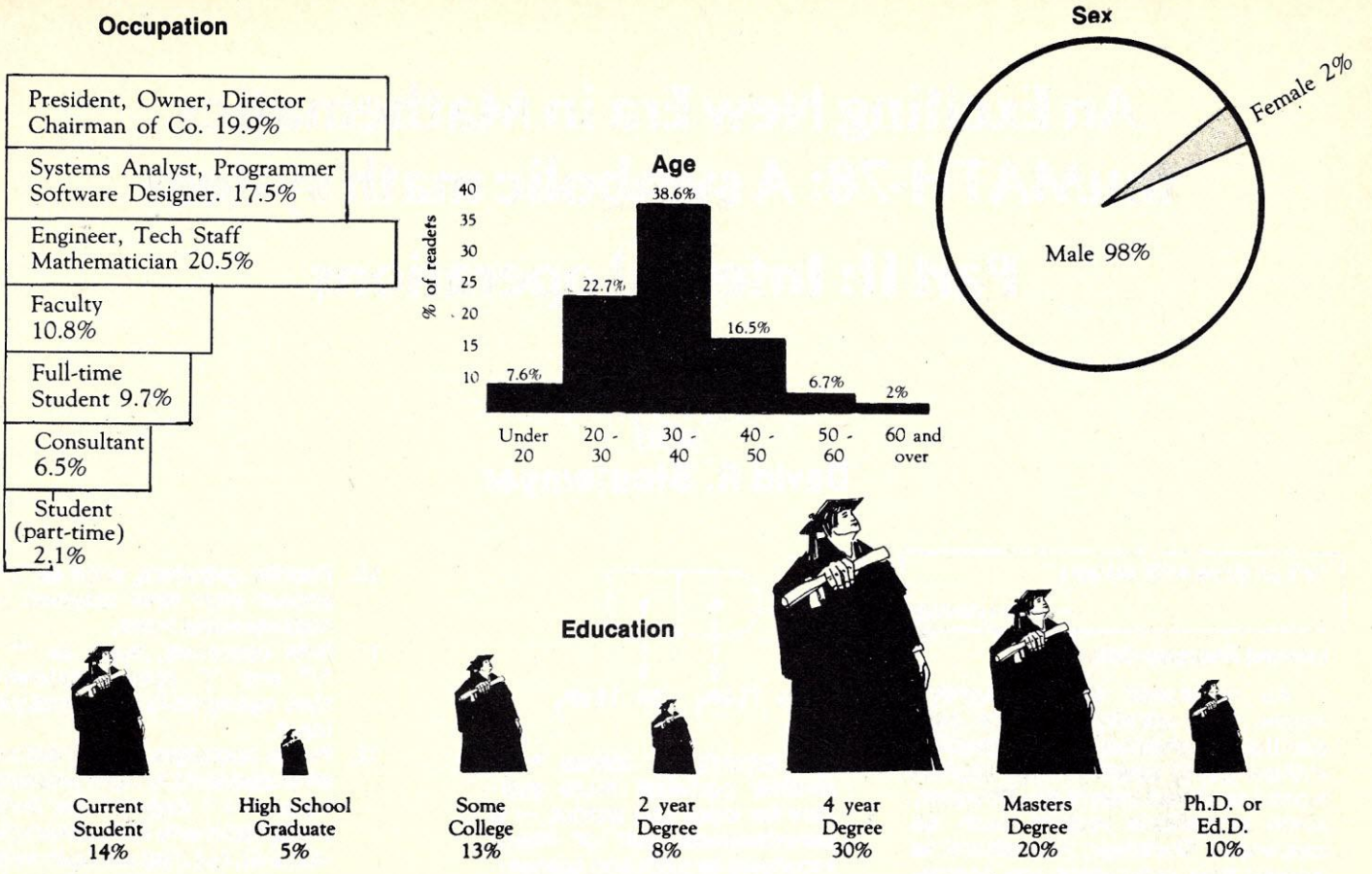
Personal Computer Ownership

Figure 4



How Many People Read Your Copy of Creative Computing?

Figure 9



Figures 5-8

A new star on the Horizon

Mike's

CSUB (Common SUBroutines)

Developed for North Star DOS and BASIC by Micro Mike's, Incorporated

CSUB is a multi-dimensional programming package. Among benefits CSUB offers both user and programmer are:

1. Non-destructive cursor positioning
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An Exciting New Era in Mathematics muMATH-78: A symbolic math system

Part II: Internal operations

Albert D. Rich
and
David R. Stoutemyer

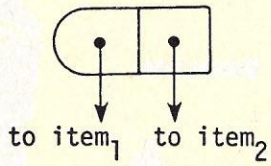
"It's all done with mirrors"
— anonymous

Internal Representation

As illustrated in last month's article, it is possible to write substantial extensions to muMath-78 without being aware of how expressions are stored internally. However, some extensions require such an awareness. Moreover, it is natural to wonder how computers can accomplish the feats demonstrated in the previous sections. Discovering how it can be done is perhaps more valuable from an educational standpoint than is the use of the facility, because the learning forces or reinforces an explicit understanding of how such feats are accomplished manually.

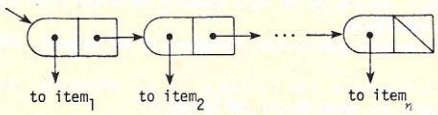
The first step toward understanding how muMath works is to understand how mathematical expressions are represented internally. Accordingly:

1. A **name** is a string of adjacent letters and digits, starting with a letter. Most other printable single characters are also names. For example, *, + and @ are names. Also, any string of characters between matching ordinary quotation marks is a name. For example, "SPEED OF LIGHT" and " " are names.
2. An **integer** is stored internally as a sign bit together with up to 254 bytes of binary data.
3. **Atoms** are either names or integers.
4. A **dotted pair** of two items is a memory cell containing the addresses of the two items. Representing an address by a **pointer** arrow, we can portray a dotted pair graphically by a diagram.



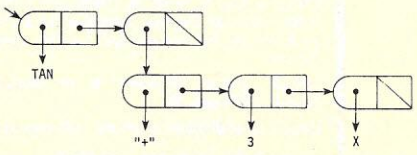
The terminology comes from another portrayal more suitable for input and output — a parenthesized pair of items separated by a dot and spaces: (item $_1$ item $_2$)

5. A **canonical fraction** is a dotted pair of an integer numerator with another relatively-prime integer denominator exceeding 1.
6. A **number** is represented as either an integer or a canonical fraction.
7. An **algebraic atom** is a number or a name.
8. A **list** is an ordered sequence of zero or more items. We can portray a list of items as a parenthesized sequence of items separated by blanks and/or commas: (item $_1$, item $_2$, ..., item $_n$). Lists are stored internally as portrayed by the corresponding diagram



where the diagonal slash represents a pointer to a special location denoting the end of all lists.

9. A **functional-form**, f(argument$_1$, argument$_2$, ..., argument$_n$), is represented internally as a list with the function name as the first item, argument$_1$ as the second item, and so on.
10. **Postfix operators**, such as "!", appear after their operand in mathematical input.
11. **Infix** operators, such as "*", "/" and "↑" appear between their operands in mathematical input.
12. **Prefix** operators appear before their operands in mathematical input. "+" and "-" are both prefix operators in the example -X/(+3), but they are both infix operators in the example X-(Y+3).
13. An **operator form** is an expression in which the last performed mathematical operation is application of an operator.
14. Operator forms are represented internally as a list with the operator name as the first item, followed by successive operands as the subsequent items. Thus, the internal representations of functional forms and operator forms are indistinguishable.
15. All symbolic math expressions are represented internally as algebraic atoms, functional forms, or operator forms. Any mathematical arguments or operands therein are represented similarly. For example, the mathematical expression TAN(3+X) is represented internally as portrayed by the diagram



or as portrayed by (TAN(+3X))

Albert Rich, David Stoutemyer, The Soft Warehouse, P.O. Box 11174, Honolulu, HI 96828.

muMath, con't...

16. The operator "/" does not occur internally, because when *v* is non-numeric, *u/v* is represented the same as *u*v*↑(-1). When only *u* is non-numeric, *u/v* is represented the same as *u**(1/*v*. When *u* and *v* are both numeric, *u/v* is represented as a canonical fraction.
17. The operator "-" does not appear internally because it is absorbed into numerical coefficients. For example, X-Y may be represented as the list (+ X (* -1 Y)).
18. For "+", associativity and commutativity are exploited to flatten sums of sums into a list consisting of the name "+" followed by 2 *or more* terms which are not sums, sorted into a canonical order. "+" is called a **variary** operator because of this treatment, resulting in a *variable* number of sorted arguments. "*" is similarly variary. The ordering algorithm for the operands of variary operators is: numbers in order of increasing value, then unbound variables in chronological order of first reference to their names, then other expressions in chronological order of first reference to the names of their top-level operator or function. When leading operators or functions are identical, ordering is according to the order of the first corresponding operands or arguments which differ, except that numerical coefficients are ignored when ordering terms of a sum, and any exponents are ignored when ordering factors of a product.

The built-in **recognizer** functions named INTEGER, NAME, ATOM, NUMBER, and ALGATOM return TRUE if their argument is of the indicated type, returning FALSE otherwise. The built-in **selector** function named FIRST returns the first item in the dotted pair or non-empty list which is its argument. For a dotted-pair argument, the built-in selector function named REST returns the second item. For a non-empty list argument, REST returns the list which is its argument without its first item. These recognizers and selectors permit us to dismantle and identify expressions as thoroughly as we wish, down to the atomic level. Conversely, for any number of arguments the built-in **constructor** function named LIST returns a list of these arguments, thus enabling us to construct arbitrary expressions. For example, suppose that we wish to implement the transformation

TAN(ATAN(U))→U.

We could do so as follows:

```
FUNCTION TAN(ANGLE),
 WHEN NOT ALGATOM(ANGLE)
 AND FIRST(ANGLE) = ATAN,
  FIRST(REST(ANGLE)) EXIT,
 LIST (TAN, ANGLE)
 ENDFUN;
```

Using the built-in functions named EQFIRST and SECOND, we can define TAN more succinctly by the equivalent definition.

```
FUNCTION TAN(ANGLE),
 WHEN EQFIRST(ANGLE,
 ATAN), SECOND(ANGLE) EXIT,
 ENDFUN;
```

Rule Definitions

Previous examples indicate how a function definition can be used to implement transformations for functions which are new to muMath. What about implementing new transformations for built-in muMath functions which already have some associated simplification rules? One way is to redefine the functions. In doing so, one can use the muMath listing of the built-in function definitions as a guide, in order to perceive how to include the built-in transformations which are still desired. However, assigning appropriate properties to functions provides an easier, more modular way for the user to supplement automatic transformations without having to understand, rewrite, or consult the built-in definitions.

In muMath, any name, including operator and function names, can have an arbitrary number of **property values** indexed according to various **property keys** of the user's choosing. In order to associate a given property value with a name under a particular key, a command of the following form is issued:

PROPERTY name, key, value;

Subsequent PROPERTY commands issued with both the same name and key will eliminate the previous property value for that name and key. The explicit removal of a property value is accomplished by the following command:

REMOVE name, key;

The distinction between operators and functions occurs only for input and output. There is no distinction in the internal representation, so for brevity we refer to a function and its arguments as an operator and its operands in the remainder of this section.

Atomic expressions are numbers or indeterminates. The **top-level** operator in a nonatomic expression is the first operator in the expression's **parse tree** or equivalently the outermost operator in the internal representation. The top-level operands are those of this operator. A **second-level** operator of such an expression is the outermost operator in a nonatomic top-level operand. In MICROMATH, a transformation rule is stored as the name of a replacement function on the property list of a top-level operator, keyed to a second-level operator.

At this point four cases must be considered. **Unary** operators are those which have 1 operand. If a top-level operator **t** is unary, and if **s** is a second-level operator of a fixed number of operands, then transformation rules of the form can be

$t(s(u_1, u_2, \ldots, u_n))\rightarrow r(u_1, u_2, \ldots, u_n)$

implemented by defining the function $r(u_1, u_2, \ldots, u_n)$ and executing the command

PROPERTY t, s, r;.

For example, to establish the rule COS (ACOS(U))→U, for all U,

we can issue the commands

```
PROPERTY COS, ACOS,
IDENTITY;
FUNCTION IDENTITY (U),
 U
 ENDFUN;
```

As another example, to establish the rule

LN(UIV)→V*LN(U), for all U and V,

when LNEXPAND is a positive multiple of 2, or when U=#E, MICROMATH-78 contains the equivalent of the commands

```
PROPERTY LN, ↑, LNEXP;

FUNCTION LNEXP(U, V)
 WHEN U=#E OR POSMULT
 (LNEXPAND, 2), V*LN(U) EXIT
 ENDFUN;
```

A second case arises when, although the top-level operator **t** is unary, the second-level operator is "+" or "*", which have an arbitrary number of operands. Here rules of the form

$t(u_1 + u_2 + \ldots + u_n)\rightarrow r(u_1, u_2, \ldots, u_n)$

or

$t(u_1 * u_2 * \ldots * u_n)\rightarrow r(u_1, u_2, \ldots, u_n)$

are implemented by making r be a function of one argument which is the list $(u_1, u_2, \ldots, u_n)$. As a specific instance, to implement the rule

$LN(u_1 * u_2 * \ldots * u_n) \rightarrow LN(u_1) + LN(u_2) + \ldots + LN(u_n)$,

for all n and all u_1 through u_n, when LNEXPAND is a positive multiple of 3, MICROMATH contains the equivalent of the commands

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```
PROPERTY LN, *, LNPROD;

FUNCTION LNPROD(FCTRS);
 WHEN POSMULT (LNEXPAND,
 3), LNPRODAUX(O) EXIT*
 ENDFUN;

FUNCTION LNPRODAUX(ANS),
 LOOP
  ANS ← ANS + LN(FIRST
  (FCTRS)),
  FCTRS←REST(FCTRS),
  WHEN EMPTY (FCTRS), ANS
  EXIT
  ENDLOOP
 ENDFUN;
```

In the event that the top-level operator is variary and the second-level operator **s** is of a fixed number of operands, rules of the form

$s(u_1, u_2, \ldots, u_m) + v \rightarrow r(v, u_1, u_2, \ldots, u_n)$

or

$s(u_1, u_2, \ldots, u_m) * v \rightarrow r(v, u_1, u_2, \ldots, u_n)$

are implemented by making **r** be a function of m + 1 variables as indicated above.

For instance, the rule

LN(U) * V→LN(U↑V), for all U and V, when LNEXPAND is a negative multiple of 2, can be implemented by the following commands:

```
PROPERTY *, LN, PRODLN;

FUNCTION PRODLN (EXPN, U),
 WHEN POSMULT (LNEXPAND,
 -2), LN(U↑EXPN) EXIT
 ENDFUN;
```

The last case involves the exponentiation operator "↑" in the top-level position. The **binary** operator "↑" is neither commutative nor associative, so rules having "↑" as the top-level operator use the property lists of the names BASE or EXPON rather than of "↑", in order to indicate which operand of "↑" has the key as its leading operator. For example, rules of the form

s(u)↑v→r(v,u)

are implemented using a command of the form

```
PROPERTY BASE, s, r;
```

and rules of the form

u↑s(v)→r(u,v)

are implemented using a command of the form

```
PROPERTY EXPON, s, r;
```

As a specific instance the built-in MICROMATH rule

#E↑LN(U)

is implemented by the equivalent of the commands

```
PROPERTY EXPON, LN, ETOLN;

FUNCTION ETOLN(BAS, U)
 WHEN BAS = #E, U EXIT
 ENDFUN;
```

Differentiation and integration rules are established as if DIF and INTG were unary operators, using a global variable named INDET as the differentiation or integration variable. For example, to establish the differentiation rule for the cotangent function:

```
PROPERTY DIF COT DIFCOT,

FUNCTION DIFCOT(EX1),
 -CSC:EX1)↑2*DIF(EX1, INDET)
 ENDFUN;
```

Parser Extentions

There are many good parsing techniques and there are enthusiastic proponents of most techniques. As with most of the recent symbolic math systems, MICROMATH uses a **Pratt parser**, because it is fast, compact, general, and extendable.

Each operator can have associated left and right **binding powers**. NOT is an example of a postfix operator, "!" is an example of a postfix operator, and "*" is an example of an infix operator. "-" is both a prefix and infix operator, as illustrated by the example -X-Y. FUNCTION, LOOP, BLOCK, WHEN and "(" are **matchfix** operators because they require respective matching delimiters ENDFUN, ENDLOOP, ENDBLOCK, EXIT and ")". "(" is exceptional because when used to designate functional forms rather than to control order of evaluation "(" can have a left operand which is a name.

Operands are integers, names which are not operator names, or the internal representations of subexpressions. For an operand between two operators, the operator with higher binding power toward the operand acquires the operand. In case of a tie, the operator on the left acquires the operand. Table 1 lists the binding powers of some of the built-in operators. As indicated there, the generous gaps permit great flexibility for the insertion of additional operators.

"Looks like you're ready to call it a day, too." ©Creative Computing

A prefix operator can be established by putting on its property list, under the key PREFIX, the desired right binding power for the operator. For example, if we wish the option of omitting parentheses from around simple arguments of logarithms, we can enter the command

```
PROPERTY LN, PREFIX, 170;
```

Thereafter, an example such as LN 5 would be equivalent to LN(5). Similarly, LN X would be equivalent to LN(X), and LN LN X would be equivalent to LN(LN(X)). More complicated examples can be decided by referring to the table of binding powers. For example, since the left binding power of * does not exceed 170, which is the right binding power of LN, LN 5*X is equivalent to (LN(5))*X rather than LN(5*X). Various alternative treatments can be implemented by choosing the right binding power appropriately.

A postfix operator is established by putting a left binding power on its property list, under the property POSTFIX. For example, to establish a postfix operator named DB, for debit, we can issue the command

```
PROPERTY DB, LBP, 160;
```

Although operators do not need to have associated function or rule definitions, an appropriate function definition for DB might be

```
FUNCTION DB (EX),
 -EX
 ENDFUN;
```

An infix operator is established by specifying its left binding power under the property LBP and specifying its right binding power under the property INFIX. For example, to establish an infix comparison operator named NE, denoting "not equal," we can enter the commands

```
PROPERTY NE, LBP, 80;

PROPERTY NE, INFIX, 80;
```

If desired, an appropriate associated function definition might be

```
FUNCTION NE (EX1, EX2),
 NOT(EX1 = EX2)
 ENDFUN;
```

More generally, a right binding power can be an expression indicating how to parse an operand or operands. Since the expression can involve arbitrary recursive, context-dependent functions, this possibility provides essentially complete generality for accomodating constructs which do not fit entirely into the standard numeric binding-power

scheme. Matchfix operators are treated this way. For example, to establish an operator named "(", which takes any number of arguments designating a set, delimited by ")", we could enter the command

PROPERTY (, RBP, MATCH((,));

MATCH is a built-in function which adjoins its first argument to a list of the parsed representations of any number of expressions separated by commas, delimited by the second argument of MATCH. Thus, as a specific example,

(3, 5, X)

would parse to the internal representation

((, 3, 5, X).

If desired, we could also define an associated function which, for example, sorts its arguments and/or deletes duplicates in order to make subsequent set operations more efficient. (Try it now as an exercise!)

Besides introducing new mathematical operators, parser extensions can be used to modify or extend the programming syntax. Since language syntax is very much a matter of personal taste, some users may wish to utilize this capability to personalize the syntax of MICROMATH to suit their individual needs and prejudices.

A **token** is an integer or a name, including names such as "+", "(", and ";". Starting with the first token of an input expression, each evaluation of the command SCAN() reads one successive token from the input stream, returning the token as the value of the command after assigning this value to a global variable also named SCAN.

Suppose a prefix or infix operator has a numeric right binding power denoted by rbp, and the first token following the operator is denoted by toke. Then the command PARSE(rbp, toke) returns the parsed representation of the right operand, after using SCAN() sufficiently often to advance the input stream to the token following this operand. If toke is the first token of an expression, then PARSE(0,toke) returns the parsed representation of the expression, after using SCAN() sufficiently often to advance the input stream to the token following the expression.

To illustrate the use of PARSE and SCAN, suppose that we wish to implement the WHILE-loop of some languages, which has the general form WHILE condition DO statement. To define this construct in terms of the more general LOOP-expression, we merely enter the commands

```
PROPERTY WHILE, PREFIX
WHILEPARSE (PARSE(0, SCAN(
)));

FUNCTION WHILEPARSE (CON-
DITION),
 WHEN SCAN = DO,
  LIST(LOOP, LIST(CONDITION,
  PARSE(0, SCAN())))
  EXIT,
 SYNTAX()
 ENDFUN;
```

The built-in function named SYNTAX prints its name followed by a colon together with the remaining unscanned portion of the input stream.

TYPE	OPERATOR	LEFT BINDING POWER	RIGHT BINDING POWER
ORDERING	(	200	0
ASSIGNMENT	—or :	180	20
NUMERICAL	!	160	0
	|	140	139
	*	120	120
	/	120	120
	+	100	100 for infix 130 for prefix
	-	100	100 for infix 130 for prefix
	=	80	80
COMPARISON	<	80	80
	>	80	80
	NOT	70	70
LOGICAL	AND	60	60
	OR	50	50

Table 1 : Binding Powers

Output and Driver Extensions

The printing of symbolic expressions in prefix, postfix, infix, and matchfix notation is done by the built-in MICROMATH-78 function named OPPRINT, which automatically takes account of numeric or MATCH binding powers to print expressions using parentheses only where necessary. However, at the expense of program size, considerably more sophisticated output formatting is possible, such as

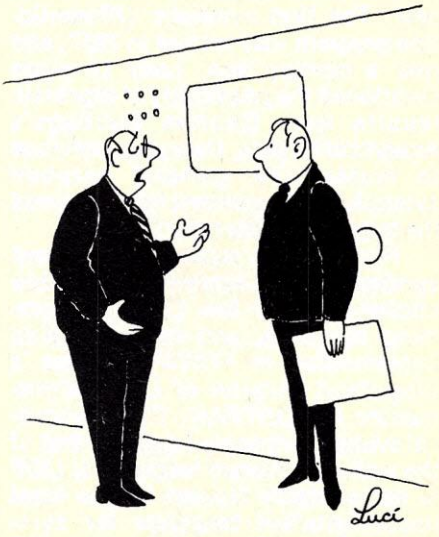
1. raising exponents,
2. printing ratios using horizontal bars to separate numerators from denominators,
3. spacing subexpressions according to subtle factors such as the depth of nesting and the amount of space remaining on a line,
4. omitting "*" when multiplication can be implied without ambiguity.

References 2 and 3 together with inspection of the OPPRINT function definition indicates how one could implement such luxuries.

The driver command (MATH) is also easily modified to suit individual tastes. This driver merely cyclically prompts, parses, evaluates, then prints successive expressions. The driver also contains a simple mechanism for reacting to syntax errors in the input expressions. Inspection of the driver suggests how various changes could be made to suit individual tastes. Such changes might include

1. a change in the prompt character,
2. elimination of the answer herald character,
3. a more sophisticated syntax-error response,
4. a different evaluation mechanism.

The purpose of this section is merely to point out that the output and the driver are easily changed, rather than to describe the built-in output and driver routines in detail. Accordingly, we have provided only one brief example of changing the driver evaluation mechanism.



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"I think we're in trouble; our computer keeps calling Dial-A-Prayer!"

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The built-in driver evaluates the parsed input by employing the command

EX1←EVAL(EX1),

where EVAL is the built-in function described previously. Proceeding outward from the innermost levels of its argument, EVAL:

1. leaves numbers as is,
2. replaces variable names with their values, if any,
3. applies the definitions of defined functions to their evaluated arguments.

To a programmer this is a natural and efficient evaluation mechanism, and it also usually satisfies mathematicians. However, this mechanism has the effect that assignments to unbound variables do not automatically affect the values of previous expressions containing these variables. Similarly, changes to option variables do not automatically affect the values of previous expressions. To accomplish these effects, we can replace EVAL(EX1) with INFEVAL (EX1) in the driver, with INFEVAL defined as follows:

```
FUNCTION INFEVAL(EX1, OLD-
EX1)
 WHEN EX1 = OLDEX1, EX1
 EXIT,
 INFEVAL(EVAL(EX1), EX1)
 ENDFUN;
```

The evaluation mechanism of EVAL is often called **1-level** evaluation, to distinguish it from this **infinite-level** evaluation, which consumes more time and storage space.

History and Distribution

Computer symbolic math is not new: The first symbolic differentiation program was written in 1957, and over a century ago, Lady Lovelace mentioned the possibility of algebraic results from Charles Babbage's Analytical Engine. However, previous to muMath-78, general purpose symbolic math systems have required the larger available machines.

Most of the recently developed symbolic math systems have been implemented in the LISP programming language, and the one being implemented in FORTRAN uses a disguised version of LISP implemented in FORTRAN. Thus, empirical evidence strongly suggests that of the well-established languages, LISP is semantically closest to the ideal implementation language for symbolic math systems. Although LISP syntax is abhorrent to many programmers, that need not concern users of LISP-implemented symbolic math systems, because all of the most recent of these provide a surface language having a widely-acceptable syntax.

Unfortunately, most LISP systems require at least 100K bytes, whether implemented in FORTRAN or otherwise. Moreover, most symbolic math systems require at least an additional 200K bytes, and the largest such system requires a total of over 1500K bytes. However, perhaps under the influence of Schumacher's economics book, **Small is Beautiful** (reference 4), we took these statistics as a challenge rather than a conclusion:

During 1977, David Stoutemyer developed some primitive symbolic math programs for the HP-67 programmable pocket calculator, as is described in reference 5. He had just begun implementing a more comprehensive 8080 version of the differentiation algorithm when he learned that Albert Rich had developed a very compact and efficient 8080 LISP interpreter called muLISP-77 , as described in reference 6. The interpreter included some upward-compatible LISP extensions which make most programs significantly shorter than with traditional LISP. Consequently, it appeared feasible that the interpreter, math programs, and symbolic expressions could fit together within the 64K bytes of storage which is the address space of typical current microcomputers.

We did not expect to have enough room to permit the luxury of both LISP and a surface language. Consequently Albert Rich implemented a variant of his interpreter called muSIMP-77 for Symbolic IMPLEmentation language, intended to be palatable to a large audience. This variant uses names such as FIRST, REST, TRUE, FALSE, and FUNCTION rather than the traditional but less mnemonic corresponding LISP names CAR, CDR, T, NIL, and LAMBDA. Moreover, muSIMP-77 uses functional, prefix, infix, and postfix notation rather than the nested parenthetical syntax of LISP.

"It likes to unwind after a long, hard day." ©Creative Computing

In 1978, Albert Rich joined an NSF-sponsored computer-symbolic-math research project directed by David Stoutemyer. One outcome of this joint research was an implementation of muMath-78 in muSIMP-77. The implementation was gratifyingly compact, efficient and comprehensive.

The muSIMP-77 source listing of the algebra system described in this article is public domain, and it has been submitted for publication elsewhere. That algebra system may be freely copied, adapted, and sold, provided it is not called muMath if altered whatsoever. (We would, of course, appreciate a reference to this article, for any system derived from this one.) In contrast, muLISP-77 and muSIMP are copyrighted.

We expect the demand for these software systems to be too large to fill on an informal basis, using University of NSF resources. Consequently, we established a company named The Soft Warehouse to handle the distribution. The names muLISP, muSIMP and muMath are trademarks of The Soft Warehouse.

The objective of the initial development of muMath-78 was to determine the feasibility of worthwhile symbolic math on computers affordable by every school, office and hobbyist. Since this objective has been fulfilled, all future maintenance and development will be done by The Soft Warehouse. Separately available from them, at prices affordable by students (5c to 10c a page), are the listing mentioned above, reference manuals for muMath-78, muSIMP-77, and muLISP-77, together with tutorial primers for each of these systems. An object-code listing of muLISP-77 or muSIMP-77 is available at a price affordable by a class, an office, or a serious computer-math hobbyist ($75). Machine-readable object versions of muLISP-77 or of muSIMP-77 together with muMath-78 are available for an additional $90 (total, $165), on any 2 distinct media of the user's choice. Currently supported media include CPM-Northstar 5¼" diskette, 5¼" Cromenco soft-sectored diskette and 5¼" Northstar diskette. All of these items may also be available from retail stores or from licensed hardware and software manufacturers.

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At a substantially higher fee, the commented muLISP-77 or muSIMP-77 assembly-language source code, flow charts, and consulting are available to software or hardware manufacturers, for adaptation to other processors, operating systems, and surface languages.

How To Learn More About Computer Symbolic Math

The ACM Special Interest Group on Symbolic and Algebraic Manipulation is the professional association for this subject. The annual membership fee is $5.00 for voting ACM members, $2.50 for student ACM members, and $8.00 otherwise, payable to ACM at P.O. Box 12105, Church Street Station, NY, NY 10249. This fee includes a subscription to the SIGSAM Bulletin, which is the source of the latest information about this rapidly developing field.

Collections of papers on the subject appear in references 7, 8, and 9. Many articles from the latter appear also in the October 1971 issue of the Journal of the ACM or in the August 1971 issue of the Communications of the ACM. The August 1966 issue of the latter journal also contains a number of articles on the subject, as will the June 1979 issue of the SIAM Journal on Computing. Chapter 4 of reference 10 treats portions of the subject, and portions of Chapter 2 in reference 11 are also applicable. References 12 and 13 contain some appropriate material of a more theoretical nature.

Acknowledgements

Development of muMath-78 was supported by NSF grant MCS7802234. We thank Peter Deutch and Martin Griss for their helpful remarks.

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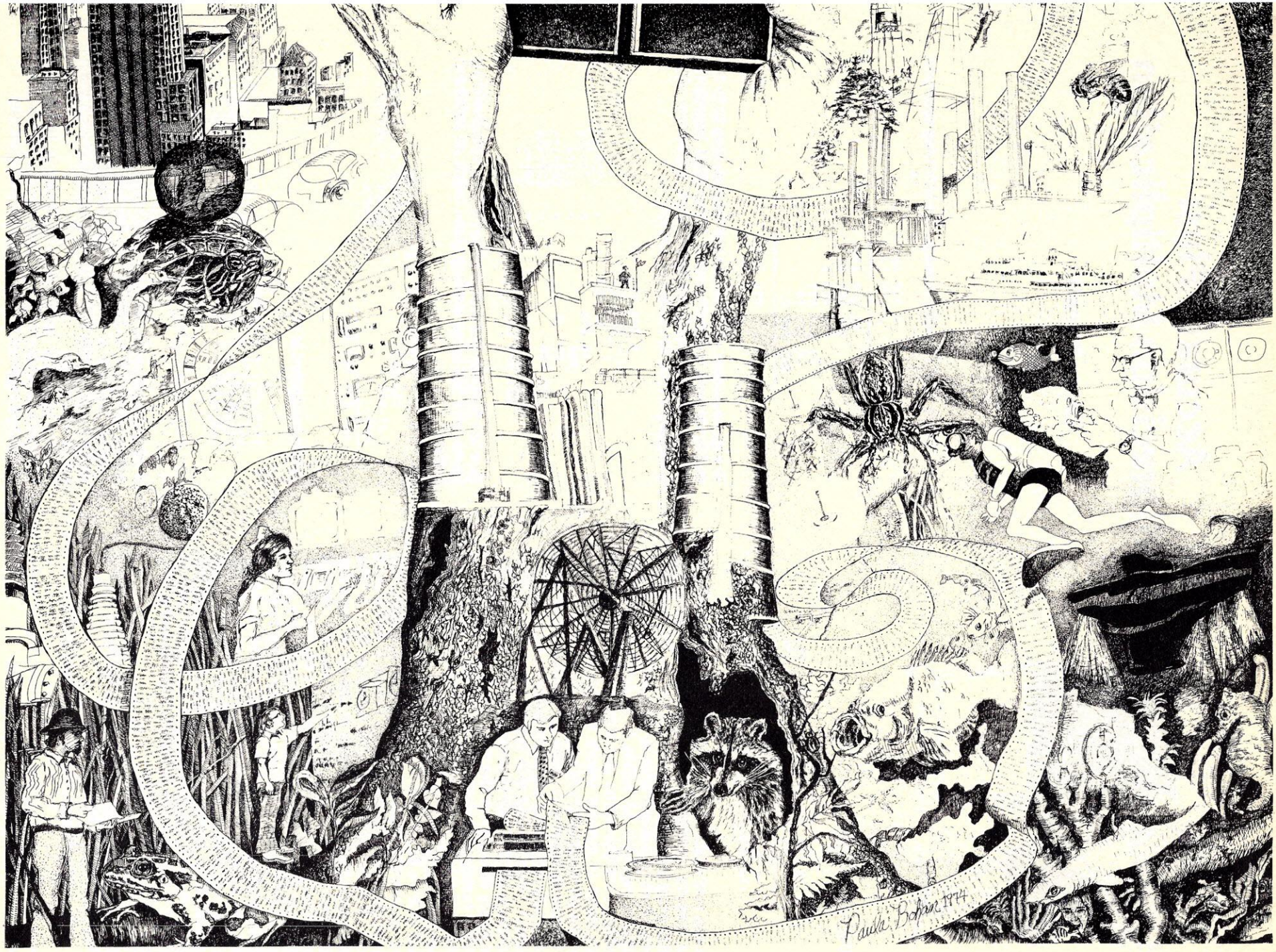

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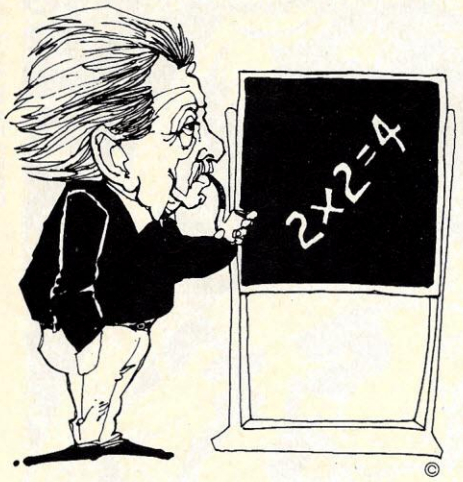

Accuracy Plus: Multiprecision Multiplication

Bruce Barnett

Did you know that

```
     15 241 578 774 577 047 238 073
X   962 858 720 375 106 022 735 947
-----------------------------------
= 146 754 870 353 856 322 393 154
  693 250 246 596 936 303 584 131
```

You can verify this result or accurately perform any of your favorite multiplication problems by using the BASIC program contained in this article. As possible applications, you might wish to calculate your monthly mortgage payment to within a millionth of a cent, precisely ascertain some gambling odds, arrive at an exact result in number theory or simply amaze your friends with the accuracy of your computer!

The accompanying program will allow you to multiply any two multi-digit numbers and give you an exact answer.[1] Once having this basic capability it then becomes an easy matter to continue the product, that is, to multiply the result of the previous multiplication by another number of your choice. If you choose to continue the product by multiplying each product by a constant, then exponentiation results, (i.e., $3x3 = 3^2 = 9$, $9x3 = 3^3 = 27$, $27x3 = 3^4 = 81$, ...). If, on the other hand, you choose to multiply each answer you obtain by consecutive integers starting at 1 then a factorial (!) results, (i.e., 1x1 = 1!, 1x2 = 2!, 1x2x3 = 3!, ...). This latter computation often arises in the art of counting when permutations and combinations are usually encountered. Though the program allows you to perform explicitly the above described computations, (e.g., calculate 2^{50} or 75!), the major benefit of the coding is that the actual multi-precision multiplication routine is written as a function, FNP$. It may be easily inserted into one of your own programs, for your own devilish purposes! It is written in Northstar BASIC but the program is sufficiently explained to enable you to modify it if your version of BASIC handles string variables somewhat differently.

The underlying algorithm is quite simple. It is essentially based upon repeated applications of the Distributive Laws of Multiplication:

$$a*(b + c) = a*b + a*c\ ;\ (d + e)*f = d*f + e*f$$

Bruce Barnett, RD#2, Box 213, Blairstown, NJ 07825.

To be specific, let's consider the following example,

```
          4 326 485
        x 205 173
-------------------
       12 979 455
      302 853 95
      432 648 5
   21 632 425
   00 000 00
  865 297 0
-------------------
  887 677 906 905
```

The same answer can be obtained by grouping both the multiplier and multiplicand in three digit segments, following the usual multiplication procedure and arranging the computation as shown:

```
          4 326 485
        x   205 173
-------------------
          83 905        =  173*485
      56 398            =  173*326
     692                =  173*4
      99 425            =  205*485
  66 830                =  205*326
 820                    =  205*4
-------------------
 887 677 906 905
```

One can simplify the computation further by combining terms with the same starting place value as exhibited below:

```
          83 905        =  173*485
      155 823           =  173*326 + 205*485
  67 522                =  173*4   + 205*326
 820                    =  205*4
-------------------
 887 677 906 905
```

This is equivalent to:

$$\begin{aligned}
&(173*10^0) * (485*10^0)\\
&(173*10^0) * (326*10^3) + (205*10^3) * (485*10^0)\\
&(173*10^0) * (\ \ 4*10^6) + (205*10^3) * (326*10^3)\\
&(205*10^3) * (\ \ 4*10^6)
\end{aligned}$$

$$= 83{,}905*10^0 + 155{,}823*10^3 + 67{,}522*10^6 + 820*10^9$$

A little reflection shows that the multiplicand has been written as $4*10^6 + 326*10^3 + 485*10^0$ and the multiplier as 205*103 + 173*100. The various subproducts result by using the Distributive Laws and having them earn their money!

The enclosed subroutine implements the above approach, whereby all multiplications are performed in three digit segments and are appropriately grouped.

Multiplication, con't...

Since the number of digits in the multiplier and multiplicand can exceed the number of digits allowed in your BASIC, it is necessary to read these values as string variables. A$ and B$ serve this purpose and in fact form the inputs to the function FNP$(A$,B$,C$). The product is placed in the output string variable C$.

A rather unusual approach is used in the following example (to describe the subroutine) which enables you to see the various subproducts and subsums being formed and manipulated and stored. The same problem seen earlier is used.

```
  L1 = 7       (Number of digits in multiplicand)
  U1 = 3       (Multiplicand is divided into 3 segments
A(1) = 485     (1st segment of multiplicand)
A(2) = 326     (2nd     '                 '     )
A(3) = 4       (3rd     '                 '     )

  L2 = 6
  U2 = 2       (Similar information as above
B(1) = 173     for the multiplier)
B(2) = 205

C(2) = A(1)*B(1)               = 485*173           =  83,905
C(3) = A(1)*B(2) + A(2)*B(1)   = 485*205 + 326*173 = 155,823
C(4) = A(2)*B(2) + A(3)*B(1)   = 326*205 +   4*173 =  67,522
C(5) = A(3)*B(2)               =   4*205           =     820

FNR(C(2)) = 905                FNR(C(4)) = 522
FNM(C(2)) =  83                FNM(C(4)) =  67
FNL(C(2)) =.  0                FNL(C(4)) =   0
FNR(C(3)) = 823                FNR(C(5)) = 820
FNM(C(3)) = 155                FNM(C(5)) =   0
FNL(C(3)) =   0                FNL(C(5)) =   0

D(1) = FNR(C(2)) + FNM(C(1)) + FNL(C(0))
     =   905     +    0      +     0        = 905

D(2) = FNR(C(3)) + FNM(C(2)) + FNL(C(1))
D(2) =   823     +    83     +     0        = 906
                    . . .

D(3) =   522     +   155     +     0        = 677
D(4) =   820     +    67     +     0        = 877
D(5) =    0      +    0      +     0        =   0

D(1) = D(1) + FNM(D(0)) = 905 + 0 = 905
D(2) = D(2) + FNM(D(1)) = 906 + 0 = 906
              ...
D(5) = D(5) + FNM(D(4)) =  0  + 0 =   0

              (These statements are
              necessary in case the
              appropriate sums exceed
              3 digits.  Thus they
              allow for any carryover
```

The remaining statements in the function, 1360-1560, check and force leading zeroes in each 3-digit segment of the answer, D( ) to be displayed, (since, for example, 053 ordinarily comes out as 53). Note that the above testing is performed in the reverse order from that which the product was calculated (see statement 1360). Therefore, testing starts from the most significant digits. S6 becomes non-zero in statement 1370 once the first non-zero partial answer is encountered and prevents a leading trio of zero digits from being displayed. You might elect to remove the REM from statement 1550 which would then place a blank between each three-digit segment of the answer for clarity in reading. This should be done only if you do not intend to perform any further operations on the answer.

Now what is ...

```
      398 133 358 946 552 076 341
    X 756 571 088 603 728 535 407
```

```
DO YOU WISH TO PRINT THE RESULTS ?  (Y OR N) ? N

DO YOU WISH TO ...
1-----MULTIPLY TWO NUMBERS
2-----EXPONENTIATE
3-----COMPUTE A FACTORIAL
4-----STOP

1, 2, 3 OR 4 ? 1

MULTIPLICAND ? 12345679
MULTIPLIER ? 27
PRODUCT IS      333333333

DO YOU WISH TO ...
1-----ENTER NEW MULTIPLICAND
2-----USE PRODUCT JUST OBTAINED AS THE MULTIPLICAND
3-----STOP
1, 2 OR 3 ? 2

MULTIPLIER ? 257689032257
PRODUCT IS      85896343999770322581

DO YOU WISH TO ...
1-----ENTER NEW MULTIPLICAND
2-----USE PRODUCT JUST OBTAINED AS THE MULTIPLICAND
3-----STOP
1, 2 OR 3 ? 3


DO YOU WISH TO ...
1-----MULTIPLY TWO NUMBERS
2-----EXPONENTIATE
3-----COMPUTE A FACTORIAL
4-----STOP

1, 2, 3 OR 4 ? 2

BASE ? 11
HIGHEST POWER ? 5

NUMBER     POWER      VALUE

11           1        11
11           2        121
11           3        001331
11           4        014641
11           5        161051

DO YOU WISH TO ...
1-----MULTIPLY TWO NUMBERS
2-----EXPONENTIATE
3-----COMPUTE A FACTORIAL
4-----STOP

1, 2, 3 OR 4 ? 3


HIGHEST FACTORIAL ? 8
NUMBER:  1
IT'S FACTORIAL: 001

NUMBER:  2
IT'S FACTORIAL: 002

NUMBER:  3
IT'S FACTORIAL: 006      DO YOU WISH TO ...
                         1-----MULTIPLY TWO NUMBERS
NUMBER:  4               2-----EXPONENTIATE
IT'S FACTORIAL: 024      3-----COMPUTE A FACTORIAL
                         4-----STOP
NUMBER:  5
IT'S FACTORIAL: 120      1, 2, 3 OR 4 ? 4

NUMBER:  6               READY
IT'S FACTORIAL: 720

NUMBER:  7
IT'S FACTORIAL: 005040

NUMBER:  8
IT'S FACTORIAL:  040320
```

Multiplication, con't...

```
10 REM  THIS IS A MULTI-DIGIT PRECISION PROGRAM
20 REM  WHICH WILL ALLOW YOU TO MULTIPLY, EXPONENTIATE OR
30 REM  COMPUTE FACTORIALS ACCURATELY.
40 REM
50 REM  THIS PROGRAM IS WRITTEN IN NORTHSTAR BASIC,
60 REM  AND CAN OUTPUT RESULTS ON A SCREEN OR A PRINTER.
70 REM
80 REM  THE FOLLOWING TWO STATEMENTS EXPLAIN THE PRINT STATEMENTS
90 REM  IN THIS PROGRAM
100 REM  PRINT #0  CAUSES THE RESULTS TO APPEAR AT THE CRT
110 REM  PRINT #2  CAUSES THE RESULTS TO APPEAR ON THE PRINTER
120 REM
130 DIM A$(400),B$(400),C$(400),A(200),B(200),C(200),D(200)
140 INPUT"DO YOU WISH TO PRINT THE RESULTS ?  (Y OR N) ? ",P$
150 IF P$(1,1)="Y" THEN P=2 ELSE P=0
160 PRINT #P
170 PRINT #P,"DO YOU WISH TO ... "
180 PRINT #P,"1-----MULTIPLY TWO NUMBERS"
190 PRINT #P,"2-----EXPONENTIATE"
200 PRINT #P,"3-----COMPUTE A FACTORIAL"
210 PRINT #P,"4-----STOP"
220 PRINT #P
230 INPUT"1, 2, 3 OR 4 ? ",I9
240 PRINT #P
250 ON I9 GOTO 290,480,640,1570,160,160,160,160,160,160
260 REM
270 REM MULTIPLICATION
280 REM
290 INPUT"MULTIPLICAND ? ",A$
300 INPUT"MULTIPLIER ? ",B$
310 C$=FNP$(A$,B$,C$)
320 PRINT #P,"PRODUCT IS       ",C$
330 PRINT
340 PRINT"DO YOU WISH TO ... "
350 PRINT"1-----ENTER NEW MULTIPLICAND"
360 PRINT"2-----USE PRODUCT JUST OBTAINED AS THE MULTIPLICAND"
370 PRINT"3-----STOP"
380 INPUT"1, 2 OR 3 ? ",I9
390 PRINT
400 ON I9 GOTO 290,410,160
410 A$=C$
420 GOTO 300
430 REM
440 REM EXPONENTIATION
450 REM
460 PRINT #P
470 PRINT #P
480 INPUT"BASE ? ",L$
490 B$=L$
500 INPUT"HIGHEST POWER ? ",B9
510 PRINT #P
520 PRINT #P,"NUMBER",TAB(10),"POWER",TAB(20),"VALUE"
530 PRINT #P
540 PRINT #P,L$,TAB(11),"1",TAB(20),L$
550 FOR I9=2 TO B9
560 C$=FNP$(L$,B$,C$)
570 PRINT #P,L$,TAB(10),I9,TAB(20),C$
580 B$=C$
590 NEXT I9
600 GOTO 160
610 REM
620 REM FACTORIAL
630 REM
640 PRINT #P
650 B$="1"
660 INPUT"HIGHEST FACTORIAL ? ",N8
670 FOR I8=1 TO N8
680 PRINT #P,"NUMBER: ",I8
690 L$=STR$(I8)
700 C$=FNP$(L$,B$,C$)
710 PRINT #P,"IT'S FACTORIAL: ",C$
720 PRINT #P
730 B$=C$
740 NEXT I8
750 GOTO 160
760 DEF FNL(X) = INT(X/1000000)
770 DEF FNM(X) = INT((X-FNL(X)*1000000)/1000)
780 DEF FNR(X) = X-FNL(X)*1000000-FNM(X)*1000
790 DEF FNP$(A$,B$,C$)
800 Q=0
810 C(0)=0
820 D(0)=0
830 C(1)=0
840 FOR K=1 TO 200
850 C(K)=0
860 D(K)=0
870 NEXT K
880 L=0
890 S6=0
900 GOSUB 1260
910 L1=L2
920 U1=U2
930 FOR K = 1 TO U1
940 A(K) = B(K)
950 NEXT K
960 D$=" "
970 G$=" "
980 A$=B$
990 FOR K=1 TO 200
1000 C(K)=0
1010 D(K)=0
1020 NEXT K
1030 L=0
1040 S6=0
1050 GOSUB 1260
1060 FOR I = 1 TO U1
1070 FOR J = 1 TO U2
1080 C(I+J) = C(I+J) + A(I)*B(J)
1090 NEXT J
1100 NEXT I
1110 S = U1+U2
1120 FOR K = 2 TO S+1
1130 D(K-1) = FNR(C(K))+FNM(C(K-1))+FNL(C(K-2))
1140 NEXT K
1150 FOR K = 1 TO S
1160 D(K) = D(K) + FNM(D(K-1))
1170 NEXT K
1180 FOR K = 1 TO S
1190 D(K) = FNR(D(K))
1200 NEXT K
1210 FOR K = 1 TO S
1220 GOSUB 1360
1230 NEXT K
1240 RETURN C$
1250 FNEND
1260 L2 = LEN(A$)
1270 X = INT(L2/3)
1280 Y = 3*X - L2
1290 IF Y = 0 THEN U2 = X ELSE U2 = X+1
1300 FOR K = 1 TO U2
1310 W = L2 - 3*K + 1
1320 IF W <= 0 THEN W = 1
1330 B(K) = VAL(A$(W,L2-3*(K-1)))
1340 NEXT K
1350 RETURN
1360 X = D(S+1-K)
1370 S6 = X + S6
1380 IF S6 = 0 THEN 1560
1390 D$ = STR$(X)
1400 IF X >= 99 THEN 1490
1410 IF X > 9 THEN 1470
1420 IF X > 0 THEN 1450
1430 G$ = "000"
1440 GOTO 1500
1450 G$ = "00" + D$(2,2)
1460 GOTO 1500
1470 G$ = "0" + D$(2,3)
1480 GOTO 1500
1490 G$ = D$(2,4)
1500 IF Q=0 THEN 1510 ELSE 1540
1510 C$=G$
1520 Q=1
1530 GOTO 1550
1540 C$=C$+G$
1550 REM C$=C$+" "
1560 RETURN
1570 END
```

Footnotes

1. One restriction is that for an 8 digit BASIC, the partial sums C(K), that are described later should not exceed 99,999,999. In an extreme case where both the multiplier and multiplicand each contain all 9's, both should not simultaneously exceed 300 digits.

□

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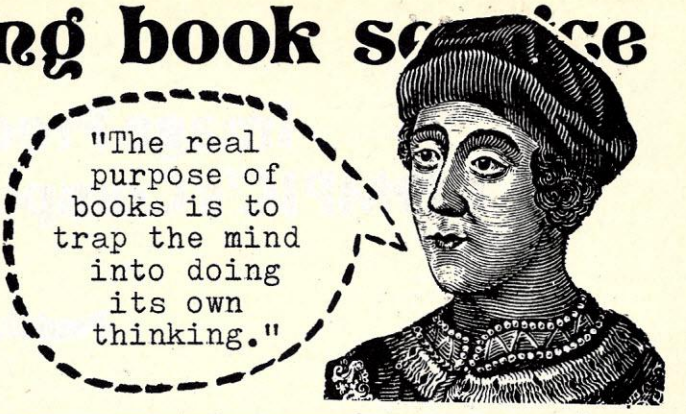

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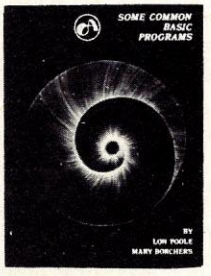

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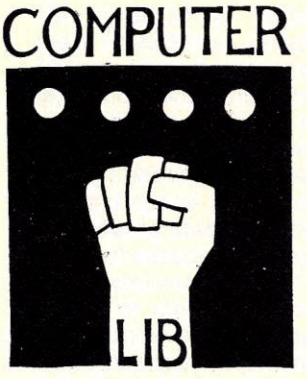

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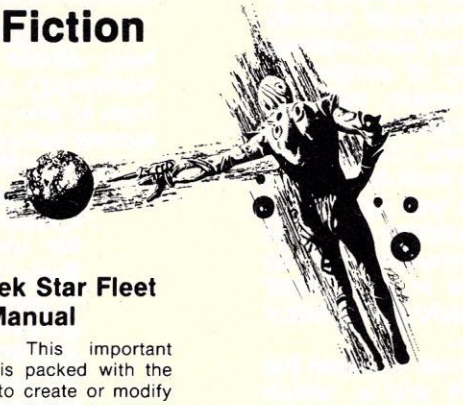

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Paul D. Johnson

Introduction

I currently own a COMPICTURE Computer Portrait System manufactured by Compic Corporation. My interest in such a system probably is different from most other system owners. I have worked as an analyst and project leader in data processing and computer science for the past ten years in business and industry and have lectured for several years at local colleges. Originally, my computer art interest was working with large mainframes in micrographics and image processing. Although I had worked with large data processing centers, my greatest problem was ready access to some kind of visual data input device. I needed devices which could scan visual images and convert them to digital data before I could embark on any creative work. I was fortunate to obtain the use of some rather sophisticated and expensive digital scanning densitometers. A few years ago, such optical scanning devices cost over several hundred thousand dollars.

Then, a couple of years ago, I came across a computer portrait machine at a trade show. Upon some investigation of the equipment, I found that it was quite a lucrative business, and was just being introduced into the market. My primary interest, however, was in using such equipment as an input device for my image processing work. At that time, there were a few manufacturers of computer portrait systems and they could be largely classified into two categories. First, there were a couple of companies who used Data General NOVA line Minicomputers or Digital Equipment Corporation PDP-8 Minicomputers as the processing units. Their prices were relatively high, in excess of $20,000 at that time for an entire computer portrait system, which included CPU with a small core memory and a CCTV system. A second group of companies offered a similar computer portrait system, but with black box type A to D conversion circuits instead of a minicomputer CPU. Their prices were lower, from $13,000 to $17,000. The difficulty with such equipment was the inflexibility of the system. It was primarily a "black box with one button" picture machine. And that was it. It would not allow me to manipulate the data within the unit or transmit the data to other host computers for processing. It also restricts any future expansion or addition of new programs.

There was one unique company, which was then the industry front-runner, and I believe it still is, which offered an ideal solution to my problem. The system, called COMPICTURE, utilizes an IMSAI microcomputer system as the processing unit and comes with four I/O ports and a keyboard in addition to all other equipment other companies normally provide. They have a sophisticated and varied software package which makes the system flexible. However, what really impressed me was their utilization of the IMSAI microcomputer system which allows me to do "my own things" including the processing of images within the unit and the transfer of data to large mainframes. It also allows addition of new programs, and has certain built-in provisions against any system obsolescence in the near future. The price of the system was competitive and was in the same range charged by the second group of companies who utilized only a black box. Thus, I decided to purchase the COMPIC System.

System in operation at the Hawthorne Community Fair.

System Configuration

Although most computer portrait system packages have similar system configurations, the digitizing technology and software structure vary significantly from system to system. Generally, a computer portrait system consists of the following three parts:

1. **The CPU unit.** The CPU unit usually contains not only a processing unit, but also analog to digital devices and memory module which can store data for one frame of image. The COMPICTURE System utilizes analog to digital as well as digital to analog circuits and some control and timing devices. The control and timing devices are utilized for synchronization of the CCTV camera with the computer CPU for control of the camera by software. It also includes relatively fast 250 nanosecond random access memory (RAM). The technique used for capturing images is direct memory access (DMA). Once data for a frame of image is captured through its video data acquisition circuits (VDA) and stored in RAM, the operator can give various commands to the CPU for printing in various formats or transferring data to

Paul D. Johnson, Compute Art Productions, 6216 Morella Ave., No. Hollywood, CA 91606.

external devices. When such commands are given, the software contained in PROM will take over the operations. For instance, when a print command is given, depending on the kind of command, the software will decide the print format and send data to its semi-intelligent graphics printer. There are two serial and two parallel I/O ports provided with the system. One serial port is usually utilized for driving a printer. One parallel port is normally used for a remote control switch. The other ports can be used for connection to various external devices.

2. **The Printer.** Since the CPU comes with two serial and two parallel ports, a wide range of selection in printers is available with the COMPICTURE System. Their standard unit usually comes with a Microdata high speed semi-intelligent graphics printer, unless other printers are requested. In my experience, this printer is extremely reliable. For the business for which the system is designed, the printer reliability is very important. In the past twelve months of operating it, I have only experienced one minor breakdown which was remedied within a matter of hours. Microdata Corporation maintains its own field service centers across the country.
3. **The CCTV System.** The image to be captured by the VDA in the CPU unit is input through a monochromatic CCTV camera. The raw image from the CCTV camera as well as the A to D converted image (or any other image processing by the CPU) can be displayed on monochromatic CCTV monitors. The COMPICTURE System utilizes a Panasonic WV341P CCTV camera with built-in viewfinder monitor, which I believe is the highest quality used in the industry. In my experience, performance of the camera has been quite satisfactory. The quality of the monitors is a relatively unimportant item. However, as many monitors as one desires can be connected to the system by daisy chain.

Besides the above three categories of equipment, a few other accessories are also provided by the system house. They include a tripod for the camera, a zoom lens and a close-up adapter lens for the camera, light stands and reflectors, and other initial stocks of supplies. Compic provides training and technical manuals as well as a marketing manual which is usually specifically prepared for the individual customer in a specific geographic area.

Figure 1 shows the overall system configuration which will help you visualize the interrelationship of the equipment.

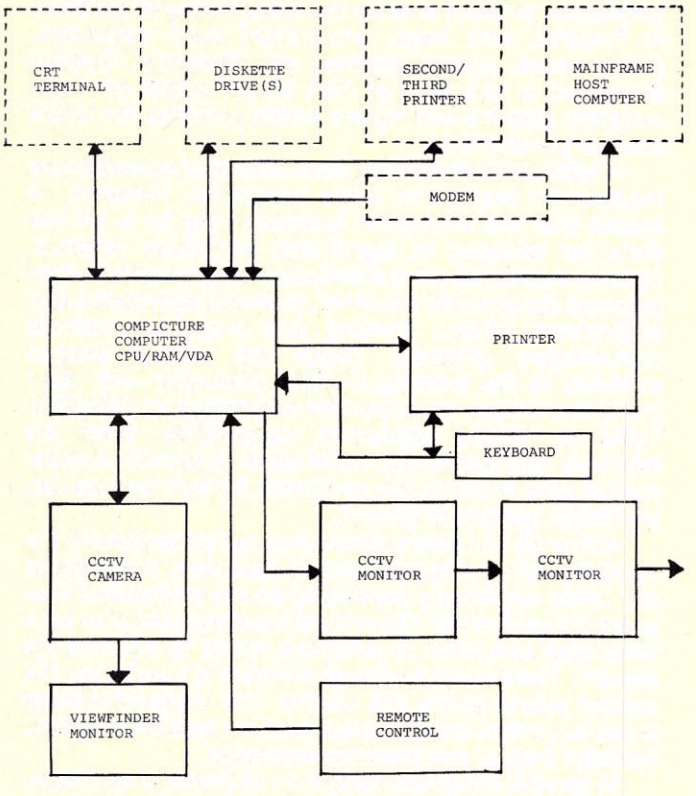


Figure 1. The CPU (Central Processing Unit) is a S-100 bus microcomputer with 2 serial I/O and 2 parallel I/O ports. Size of RAM varies from system to system. Dotted items across the top are optional.

Figure 2. COMPIC system components.

Compicture System Design Overview and Application Possibilities

The regular COMPICTURE System (Figure 2) has 120 x 128 resolution (or pixels) with 4 bit data per pixel (or 16 level of grey scale). For any computer portrait application, this resolution and grey level are sufficient. For higher quality image processing, higher resolution may be desirable; however, the 16 levels of grey scale will be more than sufficient for most uses. At higher levels of resolution, even a much lower level of grey scale will be acceptable. Many graphical terminals with resolution in excess of 512 x 512 have 2 levels (on or off) of grey and still provide a good quality image. Many people are surprised to learn that black and white photography has only five levels of grey. Compic will also provide higher resolution systems for use in computer graphics. Currently, they offer 120 x 256 resolution (capture time of 1/60 a second) and 240 x 256 resolution (capture time of 1/30 a second). I was informed that they are also working on 240 x 512 system. Those who are not interested in computer portraits, but in computer graphics, might be interested in the higher resolution VDA's.

There are a couple of notable items in the design of the COMPICTURE VDA, which may prove to be extremely useful to some. One is what they call "Grey Level Control Knobs." For normal computer portrait taking, these knobs are set at certain values and need not be adjusted. These controls decide certain parameters in their D-to-A and A-to-D circuits and allow complete flexibility in the grey level composition of the

captured image. For instance, you can "compose" the digitized image with selected grey levels. The application of such a feature is limitless, such as high or low contrast "pictures," provisions for double exposure pictures by using the different levels of contrast, etc. The high contrast pictures thus produced look very much like some poster pictures made by conventional commercial graphic arts techniques. Depending on one's interest and background, this grey level control feature will open up a number of possibilities in the areas of computer modern art and commercial graphic arts. I personally found it very useful in computer portraits also. With other portrait systems having preset grey level values, certain subjects (such as a blonde, very dark black person, or a subject in poorly lighted area) are very difficult to handle. COMPICTURE's grey level control facility is definitely a plus feature for computer artisans. (Figure 3).

Figure 3. Sample computer portrait.

Another useful feature, but one which I haven't used, is the ability to change the A-to-D transformation function via a 24-pin jumper package. Compic has several different types of jumper configurations representing different transformation functions. If you don't like any of their functions, or if you have a unique function to put in, you simply provide Compic with your equation and they will customize the jumper at a nominal charge and will mail it to you. For most computer portrait users, the use of this feature will not be necessary.

Computer Portrait Business

Man has enjoyed the recording of his own image as far back as history goes. Today, people of all ages and backgrounds continue to enjoy having their pictures taken by still photography and motion picture cameras. There are, however, certain unique features in the computer portrait "photography." It certainly lacks the resolution and detail that conventional photography provides. Nevertheless, it is a fascinating item which captures the attention of all sorts of people.

Possibly inspired by the computer graphic arts works of Harmon and Knowlton at Bell Labs in the mid-sixties, the computer portrait industry began about two and a half years ago. The first portraits were a mosaic composition of alphanumeric characters using "$" or "#" for the darkest area and "." or "," for the lightest area. At that stage, it was a novelty item resembling something out of science fiction. State fairs and amusement parks were the staple market place where it could operate. Since those days, most manufacturers have introduced methods to compose images by printing clusters of dots instead of alphanumeric characters. Compic, the first company to develop such a method, calls this technique the pencil-sketch DOT-FORMATION. It does look like a pencil sketch or charcoal drawing at a distance of about six feet. It shows considerably more details than the alphanumeric character portraits. The DOT-FORMATION method made the system more than a novelty by producing a more realistic picture quality. Although amusement parks, state fairs, beaches, and other resorts are still important outlets for the business, the main emphasis has shifted to shopping malls and trade shows such as auto shows, home shows, etc.

Another factor which changed the character of the computer portrait market was the introduction of Thermal Imaging Inked Ribbon (TIIR). When printed with TIIR, the portrait can be transferred to fabrics by the subligraphic process. Due to the nature of the subligraphic process, the fabric has to be 50 percent or more polyester for good results. This process opened up a whole new product area by the transferring of portraits to T-shirts, tote bags, pre-printed cloth calendars, pillow cases, jigsaw puzzles, etc. Recently, Compic developed a new type of TIIR which prints on heat-resistant plastics and mylars which provides for future product possibilities.

In addition to the above, most available systems now incorporate biorhythm cycle programs. However, it seems that the biorhythm business may be a bit too early for bringing in significant additional revenue. Compic system has two additional features which other systems currently do not offer: custom needlepoint and embroidery pattern printing and horoscope/portrait combination printing. These are simple plug-in modules to the existing Compic computer unit. As I indicated earlier, an important advantage of COMPICTURE is infinite expansion capabilities. Both are relatively new items and would seem to provide a wider market area in which the computer portrait system can profitably operate. (Figure 4).

Although considerable revenue can be realized in the operation of a computer portrait business, the rewards and costs vary widely depending on the market and how costs are controlled. The critical business decision for a retail type operation is deciding where to operate the system. The critical business problem is how to get the system placed where you want it. The critical business costs to control are the rental paid for operation space, operator wages, and traveling expenses.

In general the gross margin on all items is very high. It ranges from about 400% for a portrait T-shirt to as high as 1500% for paper portraits. Below is a typical monthly profit statement for an acceptable and conservatively realistic operation assuming a fixed retail location:

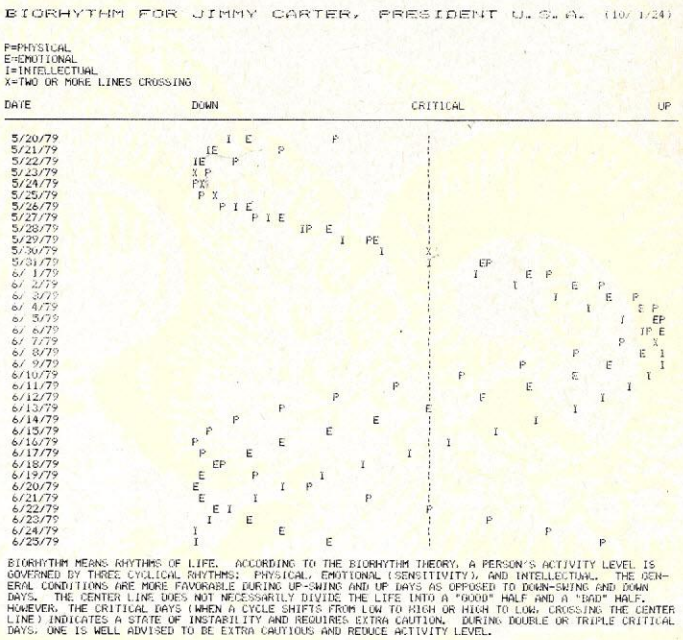
Gross Revenue	$6,000	
Cost of Sales	900	
Gross Profit		$5,100
Expenses		
Wages ($4/hr, 25 days)	$800	
Rent (20% of gross)	1,200	
Insurance	50	
Depreciation	250	
Maintenance	30	
Travel	60	
Clerical/Advertising	50	
Total expense		$2,440
Net Before Tax Profit per Mo.		$2,660

I do know some people who are easily making three times this amount; however it is necessary to obtain an excellent location in order to do that. One should be aware that in addition to the costs shown, you must take into consideration the hidden cost of the management effort needed to operate the business. As can be seen, the computer portrait business is not a get rich easy proposition; however, it can provide a means to income which can serve as a stepping stone to future financial security.

Future of Computer Art Applications

Although many geographic areas are virtually unexposed to the computer portrait products and therefore prime potential money making spots, other areas have had considerable exposure and will require creative entrepreneural talent to seek out new markets yet unexposed.

Since the Compicture System is fully programmable when a disk operating system is attached, there are many possibilities for creative image processing and generation of unique graphics which may have commercial value. I am now working on applications which involve the commercial production of prints and posters as well as custom commercial art. The future of computer art, therefore, has a lot of room to develop and will result in a lot of rewards. Compic Corporation's address is 113 N. Neil St., Champaign, IL 61820 (217) 356-1900. □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E=EMOTIONAL
I=INTELLECTUAL
X=TWO OR MORE LINES CROSSING
DATE
DOWN
CRITICAL
UP
BIORHYTHM MEANS RHYTHMS OF LIFE. ACCORDING TO THE BIORHYTHM THEORY, A PERSON'S ACTIVITY LEVEL IS GOVERNED BY THREE CYCLICAL RHYTHMS: PHYSICAL, EMOTIONAL (SENSITIVITY), AND INTELLECTUAL. THE GENERAL CONDITIONS ARE MORE FAVORABLE DURING UP-SWING AND UP DAYS AS OPPOSED TO DOWN-SWING AND DOWN DAYS. THE CENTER LINE DOES NOT NECESSARILY DIVIDE THE LIFE INTO A "GOOD" HALF AND A "BAD" HALF. HOWEVER, THE CRITICAL DAYS (WHEN A CYCLE SHIFTS FROM LOW TO HIGH OR HIGH TO LOW, CROSSING THE CENTER LINE) INDICATES A STATE OF INSTABILITY AND REQUIRES EXTRA CAUTION. DURING DOUBLE OR TRIPLE CRITICAL DAYS, ONE IS WELL ADVISED TO BE EXTRA CAUTIOUS AND REDUCE ACTIVITY LEVEL.

Figure 4. Sample of a biorhythm cycle.

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An Adventure In Small Computer Game Simulation

Scott Adams

Intent

This paper will cover the basic philosophy and structure of the data base for the Adventure Program.

What is Adventure?

Adventure is a copyrighted program designed to run on a small personal computer such as the Radio Shack TRS-80.

An Adventure consists of two parts: 1) the Adventure Program, and 2) the Adventure Data Base. Adventure is designed to allow the user to explore an imaginary world. The player travels from location to location while manipulating objects he finds there. In short, Adventure is a role playing simulation. The goal of an Adventure varies; for one it might be to discover treasures and another to perform a certain mission within a critical time limit.

Acknowledgements

To my wife Alexis for her patience, to Ted Heeren, my "sounding board" and chief play tester, to Paul Sharland for some good ideas, to the TRS Computer Club of Orlando for some good sessions, to Ron Austin of the Little Computer Co., for some good ideas, and to Crowther & Woods for the inspiration.

Scott Adams, Stromberg-Carlson, P.O. Box 3435, Longwood, FL 32750.

The player communicates with the program through 2 word English sentences consisting of a verb and a noun. Some examples and their possible results:

COMMAND	RESULT
LOOK AROUND	A description of current location is is given; also a list of all items visible here.
TAKE INVENTORY	A list of all items being carried is given.
GO NORTH	The player is moved to the location that is North of the current one.
GET AXE	If there is an axe in the current location, it would be given to the player.
ENTER HOLE	If there was a hole and the player could fit in it, he would then enter it.

Many commands could be entered in more than one way, such as:

A)	B)
RUN NORTH	LIGHT LAMP
WALK NORTH or	TURN ON
GO NORTH	LIGHT ON.

These might do the same thing.

A sample scenario from Adventure 1 follows: (Human inputs are underlined):

0
0
0

You are in a forest, visible items here are:

TREES

Obvious exits visible are NORTH, SOUTH, EAST, WEST.

Tell me what to do? CHOP TREE.
I have no axe!
Tell me what to do? YELL.
Nothing happens.
Tell me what to do? WALK NORTH.
You are in a forest. Visible items here are: TREES.
Obvious exits visible are: NORTH, SOUTH, EAST, WEST.
Tell me what to do? CLIMB TREE.
You are in the top of an oak. To the East I see a Meadow beyond that lake.
Obvious exits visible are: DOWN.
Tell me what to do? PICKUP TREE.
It's beyond my power to do that!
Tell me what to do? CLIMB DOWN.

0
0
0

(skipping further along)

0
0
0

You are on the shore of a lake. Visible items here:
Water. *Golden Fish*.
Tell me what to do? GET WATER.
I've no container!
Tell me what to do! DRINK WATER.
Boy that really hits the spot!
Tell me what to do? TAKE INVENTORY.
You are carrying: Nothing.

0
0
0

(A little later after going and getting a bottle.)

0
0
0

Tell me what to do? TAKE INVENTORY.
You are carrying: empty bottle.
Tell me what to do? SCORE.
You have stored O treasures.
On a scale of 0 to 100 that rates a O!
Tell me what to do? GET WATER.
OK, tell me what to do? TAKE INVENTORY.
You are carrying: bottle of water.

0
0
0

and so on. In this particular adventure the object is to find 13 treasures and bring them to the designated treasure room. The average playing time to do this can range from 2 days to a month depending on the resourcefulness of the player! Along the way the player finds and confronts all sorts of puzzles and problems from how to wake a sleeping dragon to the problem of stealing honey from killer bees!

What software makes up Adventure?

For an adventure there are 3 parts:

1. Adventure interpreter.
2. Adventure data base.

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Adventure, con't....

3. Adventure Editor

Adventure is so written that by changing the data base an entirely new adventure is created. The adventure editor is used to create adventure data bases which are then implemented by the adventure interpreter. The adventure editor requires a TRS-80 32K single disk system to run while a created adventure can run on TRS-80 Level-II 16K cassette system. (Usually with no memory left over!) The size of an adventure though is set when initially built with the editor. It is possible for an adventure to be written that requires a 48K system!

Adventure Data Base

The Adventure Data Base is made up of five tables: Commands, Vocabulary, Objects, Rooms and Messages. These 5 tables and a few control words are all that is needed to define a complete Adventure.

Vocabulary

The vocabulary table is broken in 2 parts: Verbs and Nouns. This allows the interpreter to run slightly faster than if the vocabulary was one long array.

In the vocabulary table is found all legal words for the Adventure. Synonyms are signified by an (*) asterisk in the first position following the main word. Example:
1) GO 2) *WALK 3) *RUN 4) EAT
Here we see Walk and Run are synonyms for Go. Wherever a vocabulary word is needed in other Adventure tables only the main word is allowed, the synonyms are only for the players input.

Certain positions are reserved in the verb and noun tables for key words. Other than that they may be in any order. Following are some key words and the positions expected: VERB: 0) AUTO 1) G 10) GET 18) DROP. NOUN: 0) ANY 1) NORTH 2) SOUTH 3) EAST 4) WEST 5) UP 6) DOWN

When the Adventure interpreter runs, it will convert the two words that the player enters into two numbers representing the respective offsets in the verb and noun tables.

Rooms

The rooms table contains all information for each location a player may find himself in. It is broken into two parts: Description and Directions. Room #0 is a "Holding" room for objects. The player never ends up here.

The Description Table contains the description of a room which will be preceded by a "I'm in a" when it's printed out or optionally if the first character is an asterisk it will be output without this. Example: DESCRIPTION Greyroom Swamp *I'm on a Branch WHAT'S OUTPUT I'm in a Grey room I'm in a swamp I'm on a branch. The Direction Table contains one entry for each of the 6 possible directions. (see Vocabulary entries 1-6). Each entry consists of a room number. Where this direction leads to or a zero if there's no exit via this direction. When the description of the room is output, the visible (all non-zero) directions are also output. Rooms may also be entered or left without benefit of this table (by using a Command table entry). Once an entry is built into the room table, it cannot change at any time while the Adventure is being played.

Example of a room:

	NORTH	SOUTH	EAST
2:	0	0	0

WEST	UP	DOWN	DESCRIPTION
0	0	0	tree

The room shown is room #2. It prints out: I'm in a tree. Visible exits are: Down. Note that when a player says GO DOWN he will end up in room #5 automatically with no entry needed in the command table. This auto transfer feature of the interpreter works for the first 6 directions found in the noun vocabulary which correspond to the direction table entries.

Objects (or Items)

This table contains all information on the various objects that will be found by the player. This table is the only one in the Data Base that is modified as the Adventure progresses. The objects table is broken into 2 main parts: room numbers and description.

The room numbers part contains the room where the object currently is. A room number of 0 says the item is currently not anywhere. And a room number of -1 says the player is carrying the item. The room numbers are what gets modified as items are moved around in the adventure.

The description part contains the description of the item followed optionally by the take/drop control.

The take/drop control is a vocabulary enclosed in slashes (/) and signifies the vocabulary word which is used to automatically take or drop this item. This will be further explained in the Command Table section.

Example of some objects: ROOM 0) -1 1) o 2) 5 3) 5 4) 0 DESCRIPTION Rusty Axe/ Axe/, Penvil/pen/, Large Tree, Empty Bottle, Bottle of Water.

In the above example, the axe is being carried, and the large tree and empty bottle are in room 5. The rusty axe can be picked up and dropped by saying GET AXE or DROP AXE. The same is true of the pencil. The bottles can only be manipulated if there are specific commands for them in the Command Table. Note that the bottle of water is in no room, possibly waiting to exchange room with the empty bottle on the player command: GET WATER (see Command Table explanation for further discussion). If the player said GET TREE and there has no entry for it in the Command Table then the message "It is beyond my power to do that" would be output automatically by the interpreter.

Messages

The message table contains all adventure messages to be output. The message numbers range from 1 to 51 and 102 to 149. Some examples: 1) Nothing Happens 2) The box exploded 3) I see no tree here 4) The dragon attacked me!

Commands

The Adventure Table contains one entry for each valid command a player may give. The table consists of two major sections: Auto Commands and Player Commands. Each command entry is broken into 3 parts: Vocabulary, Logic, Action.

The following is a typical command breakdown: The Vocabulary part consists of the verb noun which matches the players entry, such as LIGHT LAMP or CLIMB TREE if the noun is "any" then any noun is allowed. Example: A command CHOP ANY would take a player's input of CHOP or CHOP TREE or CHOP HOUSE and still be valid. Once the interpreter matches the verb and noun parts of a command to the player input, the logic section is then activated.

The logic part of a command consists of from 0 to 5 conditions which must be satisfied before the action section will be executed. If there are 0 entries here, the command is always valid; otherwise, all the logic

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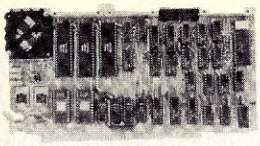

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TT-10

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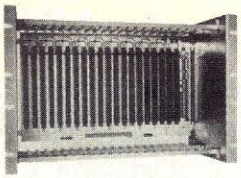

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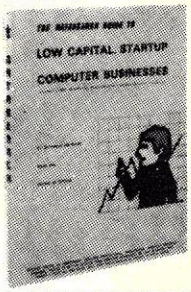

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Adventure, con't....

conditions must be met. Each logic has a secondary number associated with it depending on the logic. A short list of logics and examples follow:

LOGIC	DESCRIPTION
1	Object (Item) is on person
4	Person is in room (Item)
Example:	
1,2	says object #1 must be on person
4,20	Person must be in room 20

If any logic item proves false the interpreter continues scanning starting with the next command in the Command table.

The Action Section consists of from 1 to 4 actions which will be performed if and only if the vocabulary matches the players entry and all logic conditions are true. Note that to printout a message its number needs only to be entered as an action. Some actions require an item or two to work on. In these cases the logic list is scanned for the next item with logic control 0.

A short list of some Actions:

ACTION#	RESULT
64	Describe room, its contents and all visible exits.
70	Clear Crt screen
72	Swap room #'s of next 2 items in Command line.

Example of Typical Command Table

CMD	VERB	NOUN	LOGICS	ACTION
40	LOOK	TREE		10
41	LOOK	ANY		70 64
42	GET	WATER	2,1 3,2 0,2 0,3 0,1	72 55
43	DROP	WATER	12,2 2,1	12 11

ASSUME FOLLOWING TABLE SETUP:

OBJECTS:

ROOM	DESCRIPTION
1) 1	Water
2) -1	Empty Bottle
3) 0	Bottle of Water

MESSAGES:
10)The Tree is large
11) I've no container
12) No, I can't do that
(Player commands and what happens)

LOOK TREE 1) Command Table is searched 2) Match on Command #40 is found 3) Action Item 10 is performed. Message #10 is output "The tree is large". 4) Auto mode entered (to be explained later)

LOOK AROUND 1) Command Table is searched 2) Match on Command 41 is found 3) Action 70 is performed. Screen is cleared. 4) Action 64 is performed. Room Description is output. 5) Auto mode entered (to be explained later) Assume person in room #1.

GET WATER 1) Command Table is searched. 2) Match on command #42 is found 3) Logic 2, 1 is true. There is water in current room. 4) Logic 3,2 is true. Person is carrying empty bottle. 5) Action 72 is performed on Items 2 & 3. Empty bottle room is set to 0 and bottle of water is now being carried. 6) Action 55 is performed on Item 1. The water is removed from where it is and put into Room 0. 7) Auto mode entered.

The Object Table will now look like this:

ROOM	DESCRIPTION
1) 0	Water
2) 0	Empty Bottle
3) 1	Bottle of Water (water in the bottle is being carried)

(Using the new object table)

GET WATER 1) Command Table is searched 2) Match found on command #42 3) Logic Item 2,1 is false! Water is not in current room! 4) Command Table search continues 5) Match found on command #44 6) Logic Item 12,2 is true! Empty bottle is not in room or being carried. 7) Logic Item 2,1 is false! Water is not in current room. 8) Command Table search continues. 9) End of Command Table found 10) MSG - "I can't do that yet" is automatically output 11) Auto mode entered.

Assume following Object Table and person in room 1.

ROOM	DESCRIPTION
1) 1	Water
2) 4	Empty Bottle
3) 0	Bottle of Water

GET WATER 1) Command Table is searched 2) Match on command #42 is found 3) Logic 2,1 is true. There is water in current room (room #1). 4) Logic 3,2 is false. Empty bottle is not being carried or in room #1. 5) Command Table search continues 6) Match on command #44 is found 7) Logic 12,2 is true. Empty bottle is not in room or being carried. 8) Logic 2,1 is true. There is water in current room (room #1) 9) Action 12 is performed. Message #12 "no, I can't do that" is output. 10) Action 11 is performed. Message #11 "I've no container" is output. 11) Auto mode entered.

Mentioned earlier was the auto phase of the Command Table. The commands are built the same as in the player phase with the following differences: 1) Verb is "AUTO" 2) Noun is a number from 1 to 100 3) Unlike player phase all auto commands are scanned. In the player phase only 1 command at most is executed then player phase ends. 4) Instead of matching on players input, a match is made of a random number from 1 to 100. Therefore, a command AUTO 80 has an 80% chance of being activated during the AUTO phase. 5) The AUTO phase is always executed immediately following the player phase!

Note that by using the special flags and AUTO 100 commands any player command can be extended from the limit of only 4 actions. The AUTO commands are always found at the beginning of the Command Table and end on the first non-AUTO entry.

CMD	VERB	NOUN	LOGICS	ACTIONS
0)	AUTO	100	8,1 0,1	13 14 60
1)	AUTO	20	4,11	12
2)	AUTO	1		
3)	AUTO	1		
4)	READ	MSG	2,1 0,1	10 11 12 58

Example of Command Chaining using AUTO:

READ MSG
1) Command Table is searched 2) MATCH is found on command #4 3) Logic 2,1 is true. OBJECT #1 is in room. 4) Action 10 is performed. Message #10 is output 5) Action 11 is performed. Message #11 is output 6) Action 12 is performed. Message #12 is output 7) Action 58 is performed. Special flag 1 is set 8) AUTO mode is entered 9) Command 0 is activated 10) Logic 8,1 is true. Flag is now set. 11) Action 13 is performed. Message #13 is output 12) Action 14 is performed. Message #14 is output 13) Action 60 is performed. Special Flag Number

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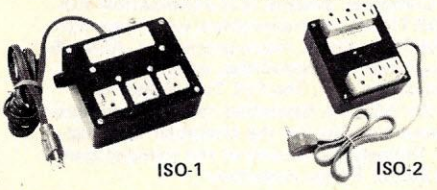

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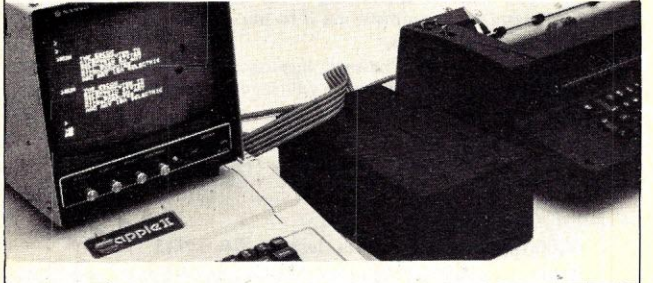

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CIRCLE 135 ON READER SERVICE CARD

Adventure, con't....

1 is reset 14) Command #1 has a 20% chance of activating. This time it does not. (Looking at command #1 we see that even if it is activated nothing will happen unless the person is in room 11 (Logic 4,11) at which time message #12 would be output.) 15) Command #2 has 1% chance of activating. This time it doesn't. 16) Command #3 has 1% chance of activating. This time it doesn't. 17) Command #4 is encountered. Verb doesn't equal AUTO. AUTO phase now exists.

One other special phase can be entered. This is the AUTO drop/get phase. If the player enters a get or drop and there is no match in the Command Table for
The the Objects Table is scanned to find the requested object. Example: If in the Command Table you have:
42) Get mud with logics and actions
43) Drop hay with logics and actions

and in the Objects Table you have:

MUD/MUD/ HAY SEEDS/SEEDS/

Following will happen:

GET MUD if command table is true it is executed otherwise "I can't do that yet" is output. DROP MUD - AUTO Drop is activated. Object is dropped. GET HAY - MSG "I don't understand your command" is output (i.e., hay cannot be picked up this way!) DROP HAY If Command Table is true, it is executed else message "I can't do that yet" is output. GET SEEDS - AUTO Get is activated. Item is picked up. DROP SEEDS - AUTO Drop is activated. Item is dropped.

The AUTO Drop feature basically means that an item can be picked up or dropped by the player by including "/NAME/" at end of the objects description, without having to enter a Get or Take command in the Command Table for each item. When the AUTO Drop/Get is activated it may also output message, such as "Item is not here" or "Item is not being carried."

Control Words

The following are some control words found in an Adventure:

SPECIAL FLAGS: There are 15 special flags (0-14) which may be set or reset by Command Action. Initially all are reset.

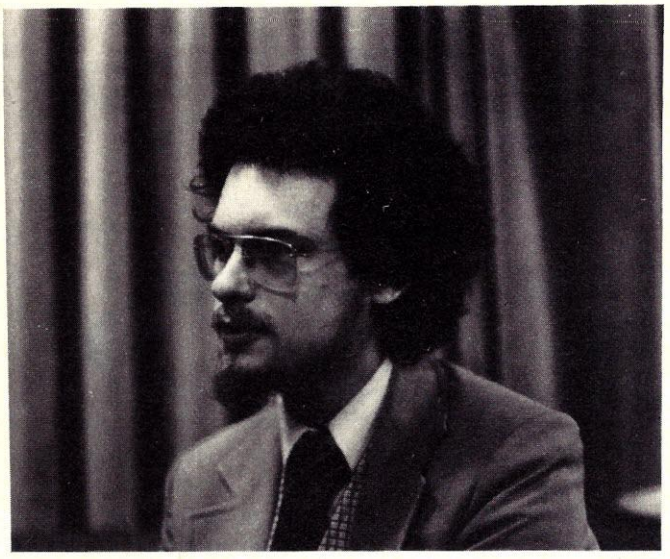
DARK FLAG: When this flag is set, then it is dark in the Adventure and unless object #9 is in the current room or being carried then it is too dark to see. Also if players move while it is dark and goes in an invalid direction he may fall and break his neck! (Object #9 is always an artificial light source!)

LIGHT BURNING: # of turns that a light source (Object #9) may burn before going out. The light is considered to be burning if person is carrying Object #9.

Summary

The Adventure Data Base is flexible, allowing a wide variety of Adventures to be written. From magic to outer space to the old west almost any scenario can be set up. *NOTE that the Adventure interpreter and Data Bases are currently available through national distributors (such as Creative Computing and Softside among others). Adventure may currently be purchased for the following computers: TRS/80, PET, CP/M, and Apple.

Adventure seems to have taken the computer world by storm. I first saw it in Toronto at the Canadian Computer Conference in 1977 running in Fortran on a prime computer. Tracking back I found it was written originally by Will Crowther and greatly expanded by Don Woods. But it goes back even further to a computerized version of Dungeons and Dragons which originated at Bolt, Beranek, and Newman, a consulting firm in Cambridge, MA. Dungeons and Dragons is a serious fantasy board game written by Gary Gygax and Dave Arneson in 1974 and published by TSR Hobbies, Inc., Lake Geneva, WI. — *DHA*



Scott Adams, creator of Adventure. □

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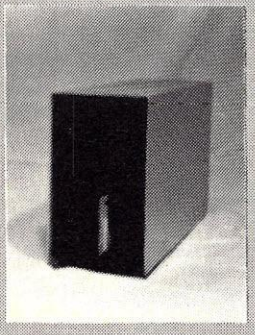

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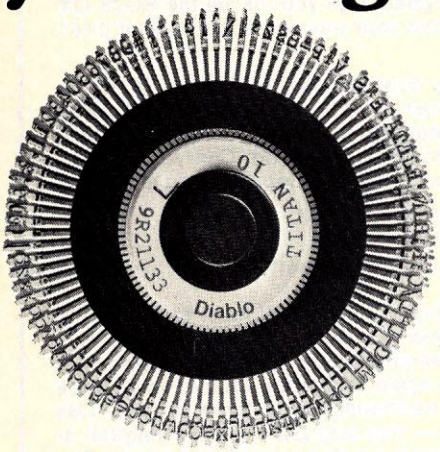

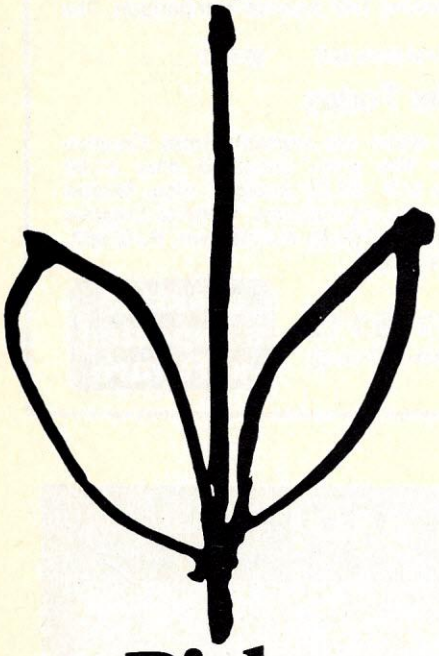

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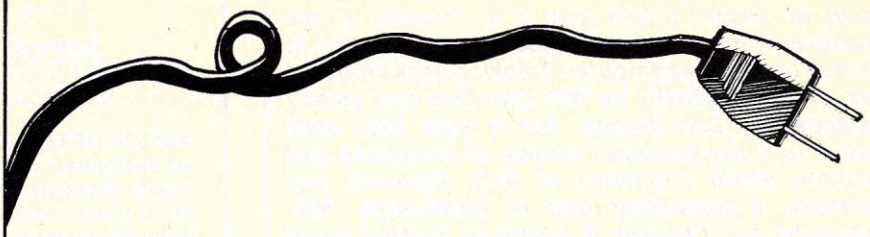
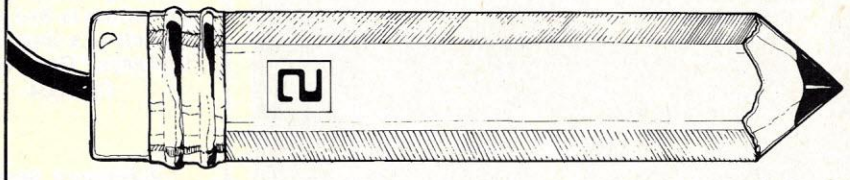


Manipulating Pencil Files Convert them to BASIC

Rosann Collins
Theodore C. Hines
George Rowan



We were not at all surprised with the expression of popularity for the Electric Pencil conveyed in the sales figures by Michael Shrayer in the recent interview with him (**Creative Computing**, February 1979). We have found the Electric Pencil a useful tool for many clerical tasks such as letter and report writing. We have also used the Pencil for gathering data such as address lists. Unfortunately, the ability to manipulate data in Electric Pencil format, such as to permit the sorting and merging of files for example, is somewhat limited. In order to do such manipulation we have written a program which converts Electric Pencil files into BASIC file format.

We have a Processor Technology Sol with 48K of memory and use the SS version of the Electric Pencil. To convert a file to BASIC format, the Pencil file is read into memory from the monitor. Then the BASIC program that peeks and writes onto a second tape is run. When inputting your data from Electric Pencil, make sure you have included some sort of end of file indicator, such as EOF, to stop the peek routine in the BASIC program.

R. Collins, T. Hines, G. Rowan, Library Science/Educational Technology Division, School of Education, University of North Carolina, Greensboro, NC 27412.

We've also written a second program which re-converts BASIC files back into Electric Pencil format for final editing and printing. This is a reversal of the process described above. The BASIC program pokes the file into memory. The data is then saved onto tape from the monitor system. The resulting file is in Pencil format, and can be read in by Pencil.

Both of these programs were written using the unit operations approach. That is, most of the program sections were already written and merely combined to suit our needs. For example, the RE-CONVERT program includes a number system converter function that will tell you where your data is in memory in both decimal and hex. This approach allows for a variety of uses of the programs as parts of other programs or as a single program that converts file form, manipulates data and re-converts file form, without ever writing off to a cassette tape in BASIC format. This method is one means of working with longer records - lengths greater than 132 characters, the maximum record length for writing to cassette in SOL BASIC. Both programs should be easily converted from SOL BASIC to whatever dialect is needed, and to whatever use you may have. □

Pencil Files, con't...

```
LIST

   10 REM-FILE CONVERTER
   20 REM-PROGRAM PEEKS FROM MEMORY TO CONVERT ELECTRIC PENCIL
   30 REM-FILE TO BASIC FILE FORM.  READ IN ELECTRIC PENCIL FILE FROM
   40 REM-MONITOR STARTING AT 5000H(20480)
   50 LET M1=20480
   60 LET A1=M1
   70 DIM A$(200),A1$(200)
   80 REM-FUNCTION PEEKS RECORDS FROM MEMORY
   90 DEF FNA1$(A1)
  100 LET A1$=""
  110 LET X1=PEEK(A1)
  120 LET A1=A1+1
  130 REM-13 IS THE LINE FEED WHICH SIGNIFIES THE END OF RECORD
  140 REM-IN ELECTRIC PENCIL
  150 IF X1=13 THEN  LET M1=A1: RETURN A1$
  160 LET A1$=A1$+CHR(X1): GOTO 110
  170 FNEND
  180 REM-OPENS CASSETTE FILE TO BE WRITTEN TO IN BASIC FORM
  190 INPUT "FILE/DRIVE TO WRITE TO? ",B$
  200 FILE #1;B$,2
  210 LET A$=FNA1$(M1)
  220 REM-ALLOWS FOR BLANK OR VERY SHORT LINES
  230 IF A$="" THEN  GOTO 210
  240 IF LEN(A$)<3 THEN 270
  250 REM-CLOSES FILE
  260 IF A$(1,3)="EOF" THEN  CLOSE #1: PRINT "CLOSED": END
  270 PRINT A$: REM- PRINTS RECORD ON C.R.T.
  280 PRINT #1;A$: REM-PRINTS RECORD ON CASSETTE TAPE
  290 GOTO 210
```

```
LIST

   10 REM-FILE RE-CONVERTER
   20 REM-PROGRAM POKES DATA INTO MEMORY TO CONVERT BASIC FILE
   30 REM-TO ELECTRIC PENCIL FORM. SAVE DATA FROM MONITOR AFTER
   40 REM-RUNNING PROGRAM, WHICH WILL TELL DATA LOCATION IN MEMORY
   50 DIM N1$(200),Z$(200)
   60 REM-FUNCTION CONVERTS DECIMAL NUMBERS TO HEX
   70 DEF FNA1$(M1,X1)
   80 LET N1$=""
   90 LET Y1=INT(X1/M1)
  100 LET Z1=X1-(Y1*M1)
  110 FOR I1=1 TO Z1+1
  120   READ Z1$
  130 NEXT I1
  140 LET N1$=Z1$+N1$
  150 RESTORE
  160 IF X1<M1 THEN  RETURN N1$
  170 LET X1=Y1: GOTO 90
  180 FNEND
  190 REM-M2 IS BEGINING OF DATA IN MEMORY
  200 LET M2=20480
  210 INPUT "FILE NAME/TAPE DRIVE TO READ FROM ? ",X$
  220 FILE #1;X$,1: REM-OPENS CASSTTE FILE TO BE READ FROM
  230 READ #1;Z$: GOTO 270: REM-READS FROM CASSETTE
  240 REM-270 CLOSES FILE AT END OF DATA
  250 GOSUB 370
  260 GOTO 230
  270 CLOSE #1
  280 PRINT "EOF"
  290 LET B1=16: REM-B1 IS BASE TO BE CONVERTED TO
  300 LET Z1=M2: REM-Z1 IS THE END OF DATA IN MEMORY
  310 REM-FUNCTION CONVERTS MEMORY LOCATIONS FROM DECIMAL TO HEX
  320 LET Y$=FNA1$(B1,Z1)
  330 PRINT "DATA ARE IN MEMORY FROM 20480 TO ";M2
  340 PRINT "HEX 5000 TO ";Y$
  350 END
  360 REM-ROUTINE POKES DATA TO MEMORY
  370 FOR I=1 TO LEN(Z$)
  380   POKE M2,ASC(Z$(I,I))
  390   LET M2=M2+1
  400 NEXT I
  410 POKE M2,13
  420 LET M2=M2+1
  430 RETURN
  440 REM-DATA FOR NUMBER BASE CONVERTER FUNCTION
  450 DATA "0","1","2","3","4","5","6","7","8","9"
  460 DATA "A","B","C","D","E","F"
```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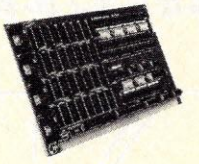
Memories...

$298[13]



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$368[16]

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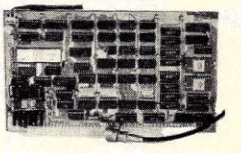

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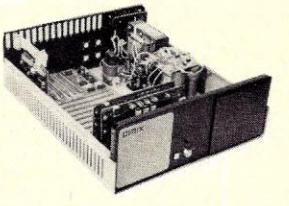

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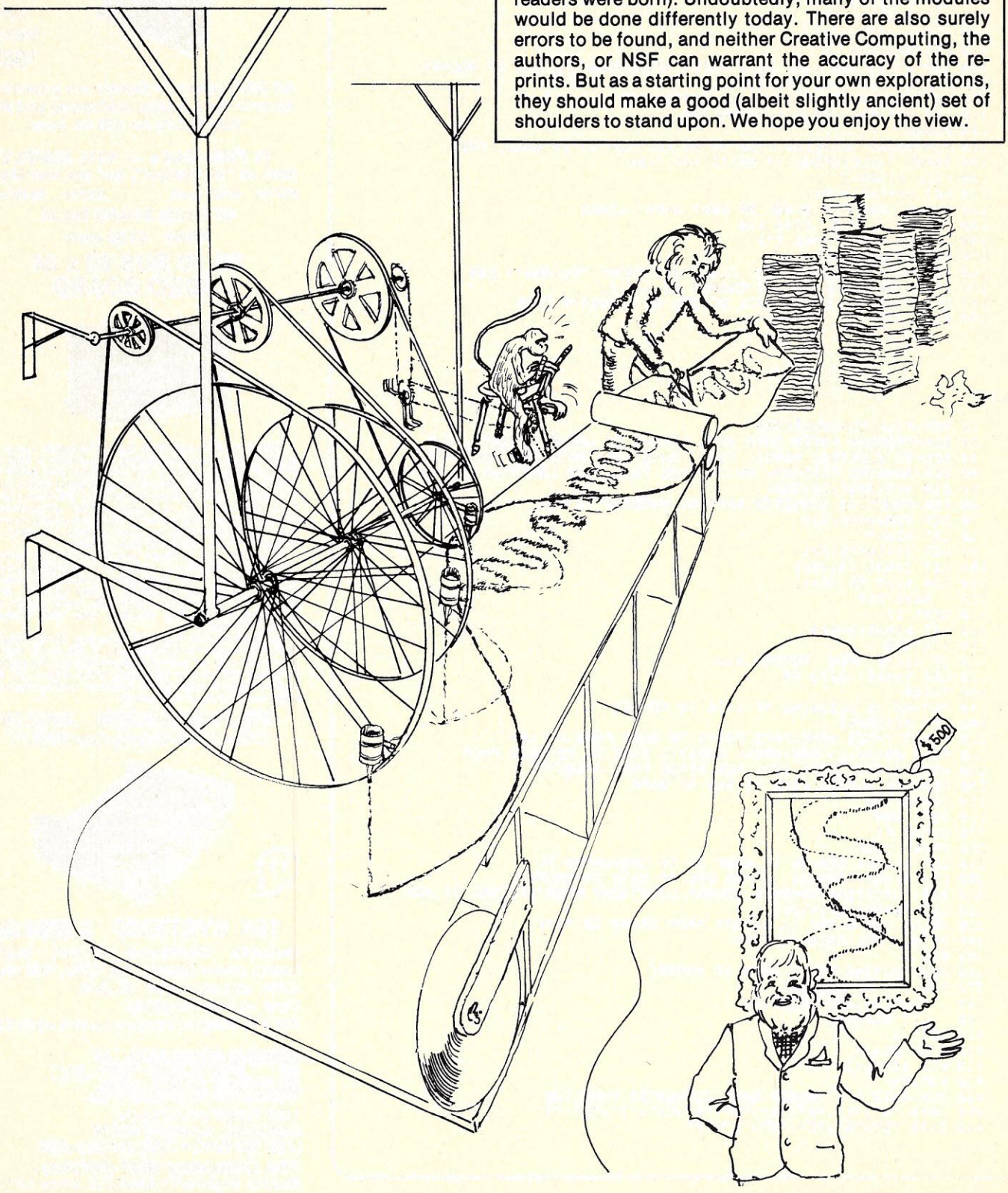
CIRCLE 138 ON READER SERVICE CARD

Circular Functions

This is a reprint of one of the original Project Solo curriculum modules developed at the University of Pittsburgh. Project Solo was supported in part by the National Science Foundation, and it was directed by Tom Dwyer and Margot Critchfield. The modules were authored by various persons, including project staff, teachers, and students.

It should be kept in mind that Project Solo began in 1969 (which is probably before **some** of Creative's readers were born). Undoubtedly, many of the modules would be done differently today. There are also surely errors to be found, and neither Creative Computing, the authors, or NSF can warrant the accuracy of the reprints. But as a starting point for your own explorations, they should make a good (albeit slightly ancient) set of shoulders to stand upon. We hope you enjoy the view.



Circular, con't...

Consider an angle A with its initial side placed along the X-axis, with its vertex at the origin P:(0,0), and with a terminal side that passes through the point P:(X,Y). Let us call the distance from (0,0) to (X,Y) R, so that $R^2 = X^2 + Y^2$. Then the six circular functions of the angle A are defined as:

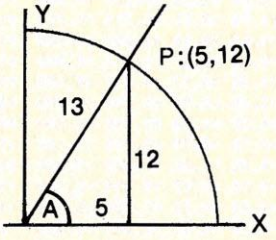
Sine of the angle = y/r	Contangent of the angle = x/y
Cosine of the angle = x/r	Secant of the angle = r/x
Tangent of the angle = y/x	Cosecant of the angle = r/y

Sample problem

Find the circular functions of an angle (A) whose terminal side passes through the point P: (5,12).

Solution

x = 5 and y = 12
therefore r = SQR (5*5 + 12*12) = SQR (169) = 13
thus sin A = 12/13 = .9231



cos A = 5/13 = .3846
tan A = 12/5 = 2.400
cot A = 5/12 = .4167
sec A = 13/5 = 2.600
csc A = 13/12 = 1.0833

Using the Computer

Figure 1 shows the flow chart for a program that asks the user to supply values for X and Y. The program then calculates SIN A, COS A, and TAN A.

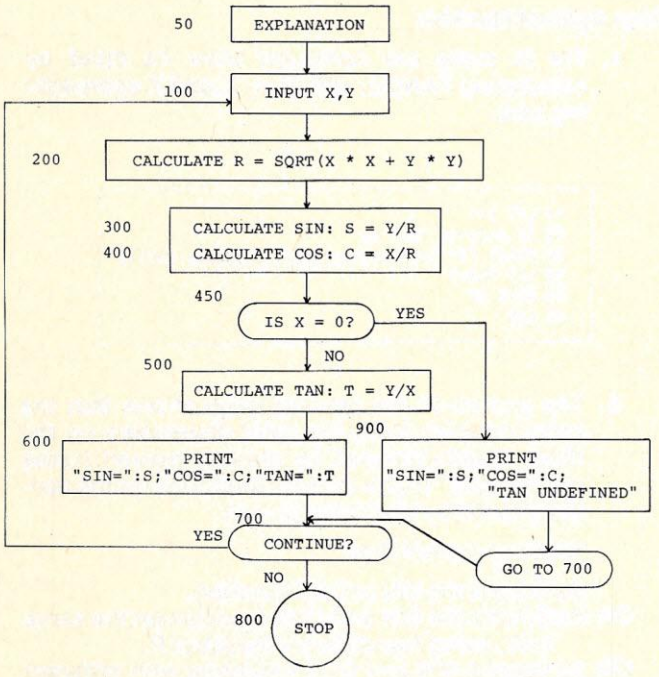


Figure 1. Flowchart for a Program to Calculate Sin, Cos, and Tan.

Notice that care is taken to avoid dividing by zero. (For which circular functions can this happen???)

Here is a program based on the flow chart in Figure 1:

```
LIST
50 PRINT "THIS PROGRAM CALCULATES THE SIN, COS, AND TAN FUNCTIONS"
60 PRINT "OF AN ANGLE A DEFINED BY THE RATIOS Y/R, X/R, Y/X"
70 PRINT "RESPECTIVELY."
80 PRINT
100 PRINT "TYPE IN THE COORDINATES OF YOUR POINT IN X,Y ORDER USING"
110 PRINT "DECIMAL FORM."
120 INPUT X,Y
200 R=SQR(X*X+Y*Y)
300 S=Y/R
400 C=X/R
450 IF X=0 THEN 900
500 T=Y/X
600 PRINT "SIN(A)=";S,"COS(A)=";C,"TAN(A)=";T
700 PRINT "DO YOU WISH TO ENTER ANOTHER POINT (ANSWER YES OR NO)";
710 INPUT R$
720 IF R$="YES" THEN 100
730 IF R$="NO" THEN 800
740 PRINT "ANSWER YES OR NO"
750 GOTO 700
800 STOP
900 PRINT "SIN(A)=";S,"COS(A)=";C,"TAN UNDEFINED"
910 GOTO 700


RUN
THIS PROGRAM CALCULATES THE SIN, COS, AND TAN FUNCTIONS
OF AN ANGLE A DEFINED BY THE RATIOS Y/R, X/R, Y/X
RESPECTIVELY.

TYPE IN THE COORDINATES OF YOUR POINT IN X,Y ORDER USING
DECIMAL FORM.
? 5,12
SIN(A)= .923077              COS(A)= .384615              TAN(A)= 2.4
DO YOU WISH TO ENTER ANOTHER POINT (ANSWER YES OR NO)? YES
TYPE IN THE COORDINATES OF YOUR POINT IN X,Y ORDER USING
DECIMAL FORM.
? 2,2
SIN(A)= .707107              COS(A)= .707107              TAN(A)= 1
DO YOU WISH TO ENTER ANOTHER POINT (ANSWER YES OR NO)? NO
```

NOTE: You must type in two decimal numbers. If you don't know a number (say the square root of 3), you can use an expression.

EXAMPLE: Suppose you want to find the circular functions for P : ($\sqrt{3}$, $\sqrt{2}$).

```
TYPE IN THE COORDINATES OF YOUR POINT IN X,Y ORDER USING
DECIMAL FORM.
? SQR(3),SQR(2)          <-- WRONG!!


RUN
THIS PROGRAM CALCULATES THE SIN, COS, AND TAN FUNCTIONS
OF AN ANGLE A DEFINED BY THE RATIOS Y/R, X/R, Y/X
RESPECTIVELY.

TYPE IN THE COORDINATES OF YOUR POINT IN X,Y ORDER USING
DECIMAL FORM.
? ^C
Break in 120
Ok
PRINT SQR(3)
 1.73205
Ok
PRINT SQR(2)                 <-- CORRECT
 1.41421
Ok
CONT
? 1.73205,1.41421
SIN(A)= .632455              COS(A)= .774597              TAN(A)= .816495
DO YOU WISH TO ENTER ANOTHER POINT (ANSWER YES OR NO)? NO
```

Circular, con't...

Computer Problems

1. Use the program above for P:(1,1), P:(0,1) P:(1,0), P:(-3,3), P:(-2,3), P:(-3,-3), P:(3,-3)

2. Modify the program given on Page 4 so that all six circular functions are calculated.
   a. Use your computer program to find the circular functions of the following:
      i. An angle A whose terminal side passes through P:(2*SQR (2), SQR (7)) NOTE: You must use an expression to find 2* SQR (2) etc.
      ii. An angle A whose terminal side passes through P:(-2.386, 7.590)
      iii. An angle A whose terminal side passes through P:(0,2.7)
      iv. An angle A whose terminal side passes through P:(2.7,0)
   b. Run your program again, supplying data on several points in all four quadrants. Can you make a general rule about the signs of the circular functions in each quadrant?
   c. Investigate angles whose terminal sides are coincident with the coordinate axes; that is, circular functions of 0, 90, 180, 360°. Which functions are undefined?

Advanced Problems

3. Write a program that automatically generates the six circular functions

FOR X = 1.0, .9, .8, .7, .6, .5, .4, .3, .2, .1, 0.
-.1, -.2, -.3, -.4, -.5, -.6, -.7, -.8, -.9, -1.0

WITH R FIXED AT R = 1 (UNIT CIRCLE).

Here is **part** of a program to do this with some output:

```
100 A$="+#.## +#.## +#.### +#.### +##.### +##.### +##.### +##.###"
110 B$="+#.## +#.## +#.### +#.###  UNDEF  +##.###  UNDEF  +##.###"
120 C$="+#.## +#.## +#.### +#.### +##.###  UNDEF  +##.###  UNDEF "
130 R=1
140 PRINT " X     Y     SIN     COS      TAN      COT      SEC      CSC"
150 FOR X=1 TO -1.1 STEP -.1
160 IF ABS(X)>=1 THEN 280
170 Y = ABS(SQR(R*R-X*X))
180 IF ABS(X)<5E-03 THEN 250
190 IF ABS(Y)<5E-03 THEN 280
200 PRINT USING A$;X,Y,Y/R,X/R,Y/X,X/Y,R/X,R/Y
210 NEXT X
230 END
```

```
RUN
 X      Y      SIN     COS      TAN      COT      SEC      CSC
+1.00 +0.00 +0.000 +1.000  +0.000  UNDEF   +1.000  UNDEF
+0.90 +0.44 +0.436 +0.900  +0.484  +2.065  +1.111  +2.294
+0.80 +0.60 +0.600 +0.800  +0.750  +1.333  +1.250  +1.667
+0.70 +0.71 +0.714 +0.700  +1.020  +0.980  +1.429  +1.400
+0.60 +0.80 +0.800 +0.600  +1.333  +0.750  +1.667  +1.250
+0.50 +0.87 +0.866 +0.500  +1.732  +0.577  +2.000  +1.155
+0.40 +0.92 +0.917 +0.400  +2.291  +0.436  +2.500  +1.091
+0.30 +0.95 +0.954 +0.300  +3.180  +0.314  +3.333  +1.048
+0.20 +0.98 +0.980 +0.200  +4.899  +0.204  +5.000  +1.021
+0.10 +0.99 +0.995 +0.100  +9.950  +0.101 +10.000  +1.005
-0.00 +1.00 +1.000 -0.000  UNDEF   -0.000  UNDEF   +1.000
-0.10 +0.99 +0.995 -0.100  -9.950  -0.101 -10.000  +1.005
-0.20 +0.98 +0.980 -0.200  -4.899  -0.204  -5.000  +1.021
-0.30 +0.95 +0.954 -0.300  -3.180  -0.314  -3.333  +1.048
-0.40 +0.92 +0.917 -0.400  -2.291  -0.436  -2.500  +1.091
-0.50 +0.87 +0.866 -0.500  -1.732  -0.577  -2.000  +1.155
-0.60 +0.80 +0.800 -0.600  -1.333  -0.750  -1.667  +1.250
-0.70 +0.71 +0.714 -0.700  -1.020  -0.980  -1.429  +1.400
-0.80 +0.60 +0.600 -0.800  -0.750  -1.333  -1.250  +1.667
-0.90 +0.44 +0.436 -0.900  -0.484  -2.065  -1.111  +2.294
-1.00 +0.44 +0.436 -1.000  -0.436  UNDEF   -1.000  UNDEF
```

Man Against Machine

4. Try to make the computer blow its mind by calculating TAN(A), with R = 1, and X approaching zero.

```
10 LET X=1
20 IF X<1E-13 THEN 60
30 PRINT "X=";X;TAB(35);"TAN(X)=";SQR(1-X*X)/X
40 LET X=X/2
50 GOTO 20
60 END
```

5. The picture on the opening page shows that the paint dripping from the paint dispensers on the three wheels (rotated by monkey power) traces out "graphs" of the circular functions on the canvas (moved by mad artist power).

   Write a program that:

   (a) Graphs the SIN or COS function.
   OR (b) Graphs the SIN and COS function on the same axis, using two different values of R.
   OR (c) Graphs SIN and COS functions with different values of R and different starting points, possibly making "Computer generated" art as your goal. □

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[LEFT]	Move cursor one position to the left
[RGHT]	Move cursor one position to the right
[UP]	Move cursor up one line
[DOWN]	Move cursor down one line
[BHOM]	Home cursor in lower left left hand corner
[HOME]	Home cursor in upper left hand corner
[-PAG]	Move up (toward top of file) one "page"
[+PAG]	Move down (toward bottom of file) one "page"
[LTAB]	Move cursor left one horizontal tab
[RTAB]	Move cursor right one horizontal tab
[GOTO]	Go to top of file (line 1)
[ARG]n[GOTO]	Go to line 'n'
[BOT]	Go to bottom of file (last line + 1)
[-SCH]	Search backwards (up) into file for the next occurence of the string specified in the last search command
[ARG]t[-SCH]	Search backwards for string 't'
[+SCH]	Search forwards (down) into the file for the next occurence of the string specified in the last search command
[ARG]t[+SCH]	Search forward for string 't'
[APP]	Append -move cursor to last character of line +1
[INS]	Insert a blank line beforere the current line
[ARG]n[INS]	Insert 'n' blank lines before the current line
[DEL]	Delete the current line, saving it in the "push" buffer
[ARG]n[DEL]	Delete 'n' lines and save the first 20 in the "push" buffer
[DBLK]	Delete the current line as long as it is blank
[PUSH]	Save current line in "push" buffer
[ARG]n[PUSH]	Save 'n' lines in the "push" buffer
[POP]	Copy the contents of the "push" buffer before the current line
[CINS]	Enable character insert mode
[CINS][CINS]	Turn off character insert mode
[BS]	Backspace
[GOB]	Gobble - delete the current character and pull remainder of characters to right of cursor left one position
[EXIT]	Scroll all text off the screen and exit the editor
[ARG][HOME]	Home Line - scroll up to move current line to top of screen
[APP][APP]	Left justify cursor on current line
[ARG][GOB]	Clear to end of line

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CIRCLE 174 ON READER SERVICE CARD

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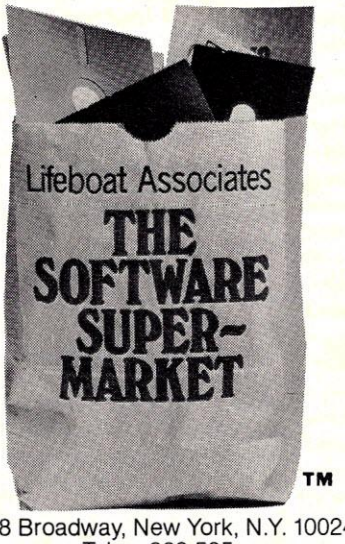

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CIRCLE 146 ON READER SERVICE CARD

Structured Programming Techniques In BASIC

Patrick C. Moyer

Regardless of the language being used, the concepts behind structured programming are worth investigating. Perhaps you can improve your programming style with these techniques.

Anyone who has read a recent data processing magazine or one of the flurry of articles on Pascal has run across the term "structured programming." Traditionally, computer programs have been written in a very idiosyncratic style. Structured programming is an attempt to formalize the logic and structure of programs. The intended result being greater programmer productivity and programs which are easier to write, debug, and maintain.

Some programming languages such as COBOL and PASCAL are specifically designed to be self-documenting. BASIC, however, was designed to be brief and to the point.

Structured programming has its origins in the concept of modular program construction. Modular programming divides every program into a number of smaller specialized subsections or modules. Each subsection of the program performs a narrow function: one module would contain input statements; another might contain calculations; another would control output and so on. The activity of these individual modules is coordinated by one module, known as the driver or mainline module. The driver orders and controls the activities of the other modules through an ordered set of call statements (in BASIC; GOSUB).

This structure provides a sharp division of labor among parts of the program. If, for instance you have a problem in output, you need only to look in the output module which is associated with that output. This can save time and effort when trying to debug a very large program. The modular style, also makes writing similar or subsequent programs easier because of the portability of modules from program to program.

In BASIC, each module would consist of either a function or a subroutine. The mainline or driver module would contain an order set of GOSUBS and/or function calls. The decision whether to use function or subroutine is based on how general the application of the module. If the exact activity is used in many different programs it might be wise to use a function: if your module is very specific to one or two programs you'd probably use the subroutine structure.

Another concept which characterizes the structured style is extensive use of internal documentation. Some programming languages such as COBOL and PASCAL are specifically designed to be self-documenting. BASIC, however, was designed to be brief and to the point. Thus a structured BASIC program must employ numerous comments (REM statements) to provide sufficient internal explanation of the program function. At the minimum, it is necessary to give a title and short one sentence description of the program's function. In addition, all modules must be labeled according to function. Figure 1 shows a listing of a structured program with the minimum necessary labeling. It should be noted a REM statement is, also, used to delineate the beginning and end of each subroutine.

The concept which sets structured programming apart from a well-documented modular program is a strict adherence to only three logic constructs. It is the structuralist's contention that any program problem can be solved using only these three logical forms. The most straightforward of these is the sequential processing form. In this form all operations are done from beginning to end in sequence with no external branches or loops. The program in Figure 1 is an example of this logical form.

```
10 REM *PROGRAM: EXAMPLE*
20 REM *THIS PROGRAM SHOWS
   SEQUENTIAL LOGICAL FORM*
30 REM *MAINLINE ROUTINE*
40 GOSUB 100
50 GOSUB 200
60 GOSUB 300
70 GOSUB 400
80 END
90 REM **********************
100 REM *INITIALIZATION ROUTINE*
110 LET A=0
120 LET B=0
130 LET C=0
140 RETURN
150 REM **********************
200 REM *INPUT ROUTINE*
210 INPUT A
220 INPUT B
230 RETURN
240 REM **********************
300 REM *CALCULATION ROUTINE*
310 LET C=A*B
320 RETURN
330 REM **********************
400 REM *OUTPUT ROUTINE*
410 PRINT A; "*"; B; "="; C
420 RETURN
430 REM **********************
```

Figure 1. Listing of a structured program.

The second logical form is the IF-THEN-ELSE logic. In structured programming all decisions must be reduced to "yes" or "no" questions. These types of decisions may be strung together to form more complex questions, but the basic decision unit

In structured programming all decisions must be reduced to "yes" or "no" questions.

must remain "yes" or "no." Control of the program must return to the next full statement after the IF or IF string. With some versions of BASIC (Applesoft II, PET, TRS-80 Level-I) the IF-THEN construct allows a GOSUB type transfer, but not an ELSE structure. In these cases, we must adapt the IF-THEN structure to allow the IF-THEN-ELSE construction. We construct our

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IF-THEN so that the line ends with a GOTO. The line number indicated would be the next line after the IF string. The ELSE is inserted by use of a REM statement for documentation purposes. The drawback to this is only executable where multiply statement lines are allowed. Figure 2 shows a listing of a program using this construct.

```
5 REM *PROGRAM: EXAMPLE 2*
10 REM *THIS PROGRAM DEMONSTRATES
   THE USE OF*
15 REM *THE CONSTRUCTED IF-THEN-ELSE*
20 REM *MAINLINE ROUTINE*
30 GOSUB 100
40 IF A=B THEN GOSUB 200: GOTO 90
50 REM *ELSE*
60 IF A>B THEN GOSUB 300: GOTO 90
70 REM *ELSE*
80 GOSUB 400
90 END
95 REM **********************
100 REM *INPUT ROUTINE*
110 INPUT A, B
120 RETURN
130 REM **********************
200 REM *EQUAL PRINT ROUTINE*
210 PRINT "A IS EQUAL TO B"
220 RETURN
230 REM **********************
300 REM *GREATER PRINT ROUTINE*
310 PRINT "A IS GREATER THAN B"
320 RETURN
330 REM **********************
400 REM *LESS PRINT ROUTINE*
410 PRINT "A IS LESS THAN B"
420 RETURN
430 REM **********************
```

Figure 2. Listing of a program using IF-THEN construct.

In other versions, the TRS-80 Level II, for instance, the full IF-THEN-ELSE structure is available, thus coding can be more straightforward. Figure 3, demonstrates this more straightforward approach.

```
5 REM *PROGRAM: EXAMPLE 2*
10 REM *THIS PROGRAM DEMONSTRATES
   THE USE OF*
15 REM *THE NATURAL IF-THEN-ELSE*
20 REM *MAINLINE ROUTINE*
30 GOSUB 100
40 IF A=B THEN GOSUB 200 ELSE IF
   A>B THEN GOSUB 300 ELSE GOSUB 400
50 END
60 REM **********************
70 END
80 REM **********************
100 REM *INPUT ROUTINE*
110 INPUT A, B
120 RETURN
130 REM **********************
200 REM *EQUAL PRINT ROUTINE*
210 PRINT "A IS EQUAL TO B"
220 RETURN
230 REM **********************
300 REM *GREATER PRINT ROUTINE*
310 PRINT "A IS GREATER THAN B"
320 RETURN
330 REM **********************
400 REM *LESS PRINT ROUTINE*
410 PRINT "A IS LESS THAN B"
420 RETURN
430 REM **********************
```

Figure 3. The IF-THEN-ELSE structure.

The third logical form is the DO-WHILE or DO-UNTIL. This form instructs the machine to perform a module until a particular condition is met. In BASIC, we would construct this form from a FOR-NEXT loop. The FOR statement would set up the condition, one or more GOSUB's would indicate what is to be done, and NEXT would indicate the end of the sequence. An example of this construct is shown in Figure 4.

```
5 REM *PROGRAM: EXAMPLE 3*
10 REM *THIS PROGRAM DEMONSTRATES THE*
15 REM *USE OF THE DO-UNTIL CONSTRUCT*
20 REM *MAINLINE ROUTINE*
30 GOSUB 200
40 FOR K=1 TO 10
50 GOSUB 300
60 NEXT K
70 FOR K=1 TO 10
80 GOSUB 400
90 NEXT K
100 GOSUB 500
110 END
120 REM **********************
200 REM *SET-UP ROUTINE*
210 DIM A(10)
220 LET B=0
230 LET K=0
240 RETURN
250 REM **********************
300 REM *INPUT ROUTINE*
310 INPUT A(K)
320 RETURN
330 REM **********************
400 REM *ADDITION ROUTINE*
410 LET B=B+A(K)
420 RETURN
430 REM **********************
500 REM *OUTPUT ROUTINE*
510 PRINT "THE TOTAL IS "; B
520 RETURN
530 REM **********************
```

Figure 4. FOR-NEXT Loop.

In actual practice a structured program will contain a number of these constructs. Notice that there are no loops or GOTO statements in the driver routine. There should be none. It is part of the structuralist's doctrine that these structures are unnecessary and thus illegal. This prohibition on GOTO's would normally extend to all portions of the program, but we must bend this rule in those cases where the IF-THEN-ELSE structure is illegal.

It has been argued that structure programming is too formalized and limits the creativity of the programmer.

The advantages to this method of programming are apparent. Increased readability and distinct division of function within the program increases the programmer's ability to find and diagnose problems. The modular construction allows portability between programs. Many programs can be built from modules which were originally designed for other applications. Programming can become merely a task of arranging and collecting modules from a standard library of routines.

There are two major disadvantages of this style for the personal user. First, the internal documentation eats up core at an amazing rate. The user must balance this core capacity against his ability to maintain his programs. Given the choice, most users would choose the short run advantage of extra core.

The second drawback is more philosophical. It has been argued that structured programming is too formalized and limits the creativity of the programmer. Many programmers feel stifled by the limited logical forms and wordiness. The philosophers of computer science will be arguing this point for years to come. For now, it is left to the individual user to decide for himself. □

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Translating Two-Dimensional Arrays For Integer BASICs

Ned W. Rhodes

The APPLE II computers (16K and larger) are shipped with two versions of BASIC. Integer BASIC is stored in ROM while the floating-point BASIC (APPLESOFT II by Microsoft) is supplied on cassette tape (APPLESOFT is also available on a $200 ROM card). One of the most frustrating omissions from Integer BASIC is the ability to define and use multi-dimensional arrays which many game and applications programs require. Some of the ways to circumvent the omission are to use APPLESOFT BASIC which supports multi-dimensional arrays, or to convert the multi-dimensional array programs to use linear arrays, or to write your own address translator that will compute the offset of the addressed element into a linear array or one-dimensional vector. This article will explore the theory behind two-dimensional arrays so that an address translation program may be developed that will allow the use of two dimensional array programs with Integer Basic.

Let's consider a 10 x 10 integer array (where each element occupies two bytes) which we define as A(10,10). For the purposes of this discussion we will also assume that the row and column indices run from one to ten. Therefore, the first element may be addressed as A(1,1) and the last element as A(10,10). Since we know that there are 100 (10 * 10) elements in the array, we could also store the same amount of information in a 100 element vector B. Then the element A(1,1) would be stored in B(1) and A(10,10) would be stored in B(100). We would then require an address translator that would map the two dimensional array address into the linear array. This address translator would return the linear offset of the desired element in the vector, given a row and column address. This type of address translation is performed by high level language interpreters and compilers.

Array Storage Considerations

Two dimensional arrays may be stored in memory using column or row representation. The two dimensional array A(10,10) would appear as

A(1,1),A(2,1),...,A(10,1),A(1,2),A(2,2),
...,A(10,2),...,A(1,10),A(2,10),...,A(10,10)

in memory when stored using column representation or as

A(1,1),A(1,2),...,A(1,10),A(2,1),A(2,2),
...,A(½,10),...,A(10,1),A(10,2),...,A(10,10)

when row representation is used. Column representation is used for the storage of FORTRAN arrays.

We can now derive an equation that will return the offset of an addressed element into a linear array, given its row and column address. I will only show the formula for column representation because the formula for row representation is easily deduced.

Address Translation Formula

If we have two dimensional array A, with the dimensions M x N and stored using column representation, the offset of element A(I,J) in a linear array is given by

Offset = (J - 1) * M + I.

If we use our previous example where A was dimensioned as 10 x 10, the offset of element A(1,1) may be computed as

[(1 - 1) * 0 + 1)] = 1.

Similarly, the offset of element A(10,10) into a linear array is

[(10 - 1) * 10 + 10)] = 100.

These numbers agree with our previous example. We may now take our two dimensional array translator formula and use it in APPLE II Integer BASIC to address two dimensional arrays.

Translator Execution Time Determination

The major purpose of this article was to add two dimensional array capabilities to APPLE's Integer BASIC. We now have a formula that allows us to do that, but what type of execution time penalties will our programs experience?

Program A loads a 900 element array with numbers and executes in approximately three seconds using Integer BASIC. If we now divide the 900 element array into a 30 x 30 two dimensional array and use our address translation formula, Program B is the result. The execution time of Program B is about 9.4 seconds. We have paid a penalty (three times slower) in execution time in this case. Program C is an APPLESOFT routine that performs the same function as Program B but uses the two-dimensional array capability built into APPLESOFT. Program C's execution time is 9.0 seconds which is only somewhat faster than Program B.

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Program A

```
 10 REM
 20 REM  THIS PROGRAM LOADS A 900 ELEMENT ARRAY
 30 REM  WITH NUMBERS AND EXECUTES IN 3.0
 40 REM  SECONDS.  IT IS WRITTEN FOR INTEGER
 50 REM  BASIC.
 60 REM
 70 REM  WRITTEN BY NED W. RHODES
 80 REM
 90 REM
100 DIM A(900)
110 FOR X=1 TO 900
120 A(X)=X
130 NEXT X
140 END
```

Program B

```
 10 REM
 20 REM
 30 REM  THIS PROGRAM TESTS THE TWO DIMENSIONAL
 40 REM  ADDRESS TRANSLATOR THAT IS WRITTEN
 50 REM  IN INTEGER BASIC.  EXECUTION TIME
 60 REM  IS 9.4 SECONDS.
 70 REM
 80 REM  WRITTEN BY NED W. RHODES
 90 REM
100 REM
110 I=0:J=0:INDEX=0:IDIM=30
120 DIM A(900): REM  A = A(30,30)
130 K=1
140 FOR J=1 TO 30
150 FOR I=1 TO 30
160 INDEX=(J-1)*IDIM+I
170 A(INDEX)=K
180 K=K+1
190 NEXT I,J
200 END
```

Program C

```
 10  REM
 20  REM
 30  REM  THIS PROGRAM EXECUTES AN APPLESOFT
 40  REM  PROGRAM THAT USES THE MULTI-DIMENSIONAL
 50  REM  CAPABILITY.
 60  REM
 70  REM  WRITTEN BY NED W. RHODES
 80  REM
 90  REM
110  DIM A%(30,30): REM  INTEGER ARRAY
120 K = 1
130  FOR J = 1 TO 30
140  FOR I = 1 TO 30
150 A%(I,J) = K
160 K = K + 1
170  NEXT I,J
180  END
```

Assembler Language Address Translator

If we are willing to live with certain limitations, we can write the two-dimensional address translator in assembler language. The translator routine requires three input parameters (I,J and the maximum row dimension) and one output parameter (the offset value into the corresponding linear array). Because no parameters may be included in either a BASIC GOSUB or an assembler subroutine CALL, we will have to use dedicated memory locations to pass these parameters.

Most BASIC interpreters divide the user area into three major areas: program area, data area and whatever is left over. In APPLE Integer BASIC, the program area is assigned to the high memory (HIMEM) locations and builds downward in memory as each line of code is entered. The data area, on the other hand, builds up from low memory (LOMEM). The free area is then the portion of memory not being used to store data or program statements. If the data area and the program area ever meet, a memory overflow message is generated.

Data is stored in the data area in a special format. First, the variable name (that may be up to 100 characters in length) is stored followed by a flag byte that is used when the TRACE mode is enabled. The "next variable address" (two bytes) is next and indicates the absolute address of the next data variable in the data area. Finally the data itself is stored as sixteen bit quantities (two bytes) where multiple sixteen bit quantities are used for linear arrays. Figure 1 illustrates the data area arrangement for four variables I, J, INDEX and IDIM. If we were to decide to use I, J, INDEX, and IDIM as the four parameters for the assembly language address translator, then we could pass data back and forth using the dedicated memory locations as indicated in Figure 1. Now, the four variables will appear in the indicated memory locations only if they are the first variables to appear in the BASIC program (because BASIC dynamically allocates space for its variables at run time) and only if low memory (LOMEM) was set to the default setting of 800 hex.

```
800: I                      VARIABLE NAME
801: DSP                    DISPLAY FLAG
802: NEXT VAR ADDR          LOW ORDER BYTE
803: NEXT VAR ADDR          HIGH ORDER BYTE
804: DATA                   LOW ORDER BYTE
805: DATA                   HIGH ORDER BYTE

806: J                      VARIABLE NAME
807: DSP                    DISPLAY FLAG
808: NEXT VAR ADDR          LOW ORDER BYTE
809: NEXT VAR ADDR          HIGH ORDER BYTE
80A: DATA                   LOW ORDER BYTE
80B: DATA                   HIGH ORDER BYTE

80C: I                      VARIABLE NAME
80D: N
80E: D
80F: E
810: X
811: DSP                    DISPLAY FLAG
812: NEXT VAR ADDR          LOW ORDER BYTE
813: NEXT VAR ADDR          HIGH ORDER BYTE
814: DATA                   LOW ORDER BYTE
815: DATA                   HIGH ORDER BYTE

816: I                      VARIABLE NAME
817: D
818: I
819: M
81A: DSP                    DISPLAY FLAG
81B: NEXT VAR ADDR          LOW ORDER BYTE
81C: NEXT VAR ADDR          HIGH ORDER BYTE
81D: DATA                   LOW ORDER BYTE
81E: DATA                   HIGH ORDER BYTE
```

Figure 1

The assembler language address translator routine is shown in Program D. The translator subroutine was called from Program E and the execution time was found to be 7.3 seconds which is about 2 seconds faster than either the address translator program written in Integer BASIC or floating-point BASIC. Table I summarizes the results of our investigations.

The results indicate that APPLE Integer BASIC may be enhanced to include two-dimensional array addressing capability provided that we are willing to live with certain limitations. It was expected that the assembler version of the address translator would be faster than the BASIC version, but the result was that it was also faster than the floating-point BASIC that has built-in multi-dimensional array addressing capability. □

Translating, con't...

Program E

```
 10 REM
 20 REM
 30 REM  THIS PROGRAM TESTS THE TWO DIMENSIONAL
 40 REM  ADDRESS TRANSLATOR THAT IS WRITTEN
 50 REM   IN ASSEMBLER LANGUAGE. EXECUTION TIME
 60 REM   IS 5.0 SECONDS.
 70 REM
 80 REM  WRITTEN BY NED W. RHODES
 90 REM
100 REM
110 I=0:J=0:INDEX=0:IDIM=30
120 DIM A(900): REM  A = A(30,30)
130 K=1
140 FOR J=1 TO 30
150 FOR I=1 TO 30
160 CALL 768
170 A(INDEX)=K
180 K=K+1
190 NEXT I,J
200 END
```

Table 1

METHOD	TIME (SEC)
INTEGER BASIC LINEAR ARRAY	2.9 to 3.0
APPLESOFT BASIC INTEGER ARRAY	8.9 to 9.0
APPLESOFT BASIC REAL ARRAY	8.9 to 9.0
INTEGER BASIC ADDR TRANSLATOR (ASSEMBLER)	7.2 to 7.3
INTEGER BASIC ADDR TRANSLATOR (BASIC)	9.3 to 9.4

©Creative Computing

"Sssssh! Be right with you, dear...just got to zap one more Klingon..."

Program D

```
1000 *
1010 *
1020 *    THIS PROGRAM PERFORMS AN ADDRESS
1030 *    TRANSLATION FOR TWO DIMENSIONAL
1040 *    ARRAYS THAT HAVE (IDIM,JDIM)
1050 *    DIMENSIONS.
1060 *
1070 *    THIS PROGRAM PICKS UP THE INDICE
1080 *    I FROM LOCATIONS 804 AND 805.
1090 *    THE J INDICE IS PICKED UP FROM LOCATIONS
1100 *    80A AND 80B.  THE COMPUTED
1110 *    OFFSET IS STORED BACK TO LOCATIONS
1120 *    814 AND 815 AND THE ITH DIMENSION
1130 *    IS PICK UP AT LOCATIONS 81D AND 81E.
1140 *
1150 *    WRITTEN BY NED W. RHODES
1160 *
1170 *
1180 MUL  .EQ $FB63      ROM MULTIPLY ROUTINE
1190 ACCL .EQ $50        MULTIPLY
1200 ACCH .EQ $51        SCRATCH
1210 AUXL .EQ $54        PAD
1220 AUXH .EQ $55        REGISTERS
1230 XTNH .EQ $53        FOR SIXTEEN
1240 XTNL .EQ $52        BIT MULTIPLY
1250 IL   .EQ $804       INDICE
1260 IH   .EQ $805          I
1270 JL   .EQ $80A       INDICE
1280 JH   .EQ $80B          J
1290 INXL .EQ $814       RETURNED
1300 INXH .EQ $815       OFFSET
1310 DIML .EQ $81D       THE I
1320 DIMH .EQ $81E       DIMENSION
1330      .OR $300       START PROGRAM AT 300 HEX
1340 INDC CLD            CLEAR DECIMAL MODE
1350      CLC            CLEAR CARRY
1360      LDA JL         GET J
1370      ADC #$FF       ADD -1
1380      STA ACCL       SAVE IT
1390      LDA JH         GET J
1400      ADC #$FF       J = J - 1
1410      STA ACCH       SAVE IT
1420      LDA DIML       GET I DIMENSION
1430      STA AUXL       SAVE IT
1440      LDA DIMH       GET HIGH ORDER
1450      STA AUXH       AND SAVE
1460      LDA #0         GET A CONSTANT 0
1470      STA XTNL       SAVE IT
1480      STA XTNH       SAVE IT
1490      JSR MUL        PERFORM MULTIPLY
1500      CLC            CLEAR CARRY
1510      LDA ACCL       GET LOW ORDER RESULT
1520      ADC IL         ADD INDICE I
1530      STA INXL       SAVE IN INDEX
1540      LDA ACCH       DO THE SAME
1550      ADC IH         WITH THE HIGH
1560      STA INXH       ORDER BYTE
1570      RTS            RETURN
1580      .EN
```

```
0300- D8
0301- 18
0302- AD 0A 08
0305- 69 FF
0307- 85 50
0309- AD 0B 08
030C- 69 FF
030E- 85 51
0310- AD 1D 08
0313- 85 54
0315- AD 1E 08
0318- 85 55
031A- A9 00
031C- 85 52
031E- 85 53
0320- 20 63 FB
0323- 18
0324- A5 50
0326- 6D 04 08
0329- 8D 14 08
032C- A5 51
032E- 6D 05 08
0331- 8D 15 08
0334- 60
```

```
SYMBOL TABLE

MUL   FB63    ACCL  0050    ACCH  0051
AUXL  0054    AUXH  0055    XTNH  0053
XTNL  0052    IL    0804    IH    0805
JL    080A    JH    080B    INXL  0814
INXH  0815    DIML  081D    DIMH  081E
INDC  0300
```


References

Maurer, Ward Douglas. **Programming: An Introduction to Computer Techniques.** Holden-Day Inc., San Francisco, 1972.

APPLE II Reference Manual, APPLE Computer Inc., Cupertino, 1978.

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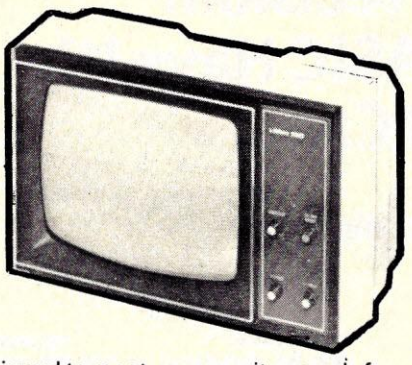

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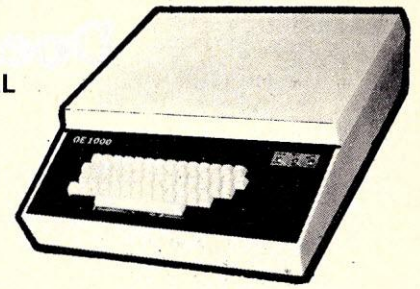

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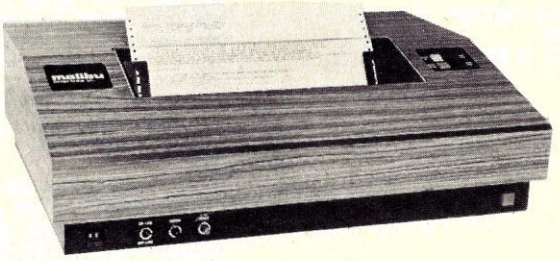

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Delmar D. Hinrichs

A major shortcoming of TRS-80 Level II BASIC by Microsoft is that its math functions will not give double precision results. If you use any of the built-in math functions except ABS, INT, or FIX on your double precision variables, you get only a single precision result, with garbage filling out the less significant digits of your result. For many applications, six significant digits are not enough. Probably some of the other extended BASICs have this problem also. In addition, some BASICs do not have math functions, or have inaccurate functions.

What can you do about this? You can use BASIC language routines to calculate the math functions in double precision, or in whatever precision your BASIC provides. Program A contains short routines to calculate all of the common math functions: square root, sine, cosine, tangent, arctangent (in radians or degrees), logarithm, exponential (natural or base 10) and, power (y^x). While the program uses a menu selection for demonstration purposes, the routines are intended to be removed from the program and used as separate subroutines. All of the routines are written in a similar format to make conversion to subroutines easy. Program A requires about 7900 bytes of free memory to run.

Program A. Demonstration Program for Double Precision Mathematics Functions.

```
10 CLS
20 PRINT "<<<<<  DOUBLE PRECISION MATHEMATICS FUNCTIONS  >>>>>"
30   '  -  -  -  -     BY D. D. HINRICHS     -  -  -  -
40   '  -  -     FOR THE TRS-80 WITH LEVEL II BASIC     -  -
50 PRINT "     1.  SQUARE ROOT"
60 PRINT "     2.  SINE  (RADIANS)"
70 PRINT "     3.  SINE  (DEGREES)"
80 PRINT "     4.  COSINE  (RADIANS)"
90 PRINT "     5.  COSINE  (DEGREES)"
100 PRINT "     6.  TANGENT  (RADIANS)"
110 PRINT "     7.  TANGENT  (DEGREES)"
120 PRINT "     8.  ARCTANGENT  (RADIANS)"
130 PRINT "     9.  ARCTANGENT  (DEGREES)"
140 PRINT "    10.  LOGARITHM  (NATURAL)"
150 PRINT "    11.  LOGARITHM  (BASE 10)"
160 PRINT "    12.  EXPONENTIAL  (NATURAL)"
170 PRINT "    13.  EXPONENTIAL  (BASE 10)"
180 PRINT "    14.  POWER  (Y|X)"
190 INPUT "ENTER NO. FOR THE FUNCTION THAT YOU WANT TO USE" ; N
200 CLS : IF N>0 AND N<15 AND INT(N)=N GOTO 220
210 PRINT "YOUR ENTRY "; N ;" IS ILLEGAL.  TRY AGAIN" : GOTO 50
220 ON N GOTO 9790, 9800, 9810, 9820, 9830, 9840, 9860,
    9880, 9900, 9910, 9930, 9950, 9960, 9970
230 END
240   '
250   '  -  -  -  -  -   ALL ROUTINES AFTER THIS   -  -  -  -  -
260   '
9790   '  SQUARE ROOT ROUTINE
9791 DEFDBL P-Y : DEFINT I-N : J=2
9792 INPUT "ENTER X FOR SQUARE ROOT(X) "; X
9793 S=X : IF X=0 GOTO 9797
9794 IF X<0 PRINT"**** ERROR,  SQ.  ROOT NEGATIVE NO. " :GOTO 9792
9795 S=SQR(X)                    PRELIMINARY VALUE OF SQUARE ROOT
9796 V=S :S=(X/S+S)/J :IF S<>V GOTO 9796          '  ADJUST VALUE
9797 PRINT "THE SQUARE ROOT OF  " ; X ; "  IS  " ; S
9798 PRINT : GOTO 9792                    '  RETURN FOR NEXT ENTRY
9799   '
9800   '  SINE ROUTINE, ANGLE IN RADIANS
9801 DEFDBL P-Y : DEFINT I-N : J=2 : PI=3.1415926535897932
9802 INPUT "ENTER ANGLE IN RADIANS FOR SINE(X) " ; X
9803 Y=X : R=0 : IF ABS(Y)>PI THEN R=FIX(Y/PI) : Y=Y-R*PI
9804 M=0 : N=1 : S=Y : T=Y : U=-Y*Y
9805 V=S :M=M+J :N=N+J :T=T*U/(M*N) :S=S+T :IF S<>V GOTO 9805
9806 IF INT(R/J) <> R/J THEN S=-S
9807 PRINT "SINE OF  " ; X ; "  RADIANS IS  " ; S
9808 PRINT : GOTO 9802                    '  RETURN FOR NEXT ENTRY
9809   '
9810   '  SINE ROUTINE, ANGLE IN DEGREES
9811 DEFDBL P-Y :DEFINT I-N :J=2 :P=180 : PI=3.1415926535897932
9812 INPUT "ENTER ANGLE IN DEGREES FOR SINE(X) " ; X
9813 Y=X : R=0 : IF ABS(Y)>P THEN R=FIX(Y/P) : Y=Y-R*P
9814 Y=Y*PI/P : M=0 : N=1 : S=Y : T=Y : U=-Y*Y
9815 V=S :M=M+J :N=N+J :T=T*U/(M*N) :S=S+T :IF S<>V GOTO 9815
9816 IF INT(R/J) <> R/J THEN S=-S
9817 PRINT "SINE OF  " ; X ; "  DEGREES IS  " ; S
9818 PRINT : GOTO 9812                    '  RETURN FOR NEXT ENTRY
9819   '
9820   '  COSINE ROUTINE, ANGLE IN RADIANS
9821 DEFDBL P-Y : DEFINT I-N : J=2 : PI=3.1415926535897932
9822 INPUT "ENTER ANGLE IN RADIANS FOR COSINE(X) " ; X
9823 Y=X : R=0 : IF ABS(Y)>PI THEN R=FIX(Y/PI) : Y=Y-R*PI
9824 M=-1 : N=0 : Q=1 : T=1 : U=-Y*Y
9825 V=Q :M=M+J :N=N+J :T=T*U/(M*N) :Q=Q+T :IF Q<>V GOTO 9825
9826 IF INT(R/J) <> R/J THEN Q=-Q
9827 PRINT "COSINE OF  " ; X ; "  RADIANS IS  " ; Q
9828 PRINT : GOTO 9822                    '  RETURN FOR NEXT ENTRY
9829   '
9830   '  COSINE ROUTINE, ANGLE IN DEGREES
9831 DEFDBL P-Y :DEFINT I-N :J=2 :P=180 : PI=3.1415926535897932
9832 INPUT "ENTER ANGLE IN DEGREES FOR COSINE(X) " ; X
9833 Y=X : R=0 : IF ABS(Y)>P THEN R=FIX(Y/P) : Y=Y-R*P
9834 Y=Y*PI/P : M=-1 : N=0 : Q=1 : T=1 : U=-Y*Y
9835 V=Q :M=M+J :N=N+J :T=T*U/(M*N) :Q=Q+T :IF Q<>V GOTO 9835
9836 IF INT(R/J) <> R/J THEN Q=-Q
9837 PRINT "COSINE OF  " ; X ; "  DEGREES IS  " ; Q
9838 PRINT : GOTO 9832                    '  RETURN FOR NEXT ENTRY
9839   '
9840   '  TANGENT ROUTINE, ANGLE IN RADIANS    (ALSO SIN & COS)
9841 DEFDBL P-Y : DEFINT I-N : I=1 : PI=3.1415926535897932
9842 INPUT "ENTER ANGLE IN RADIANS FOR TANGENT(X) " ; X
9843 Y=X : R=0 : IF ABS(Y)>PI THEN R=FIX(Y/PI) : Y=Y-R*PI
9844 M=I : Q=I : S=I : T=I : U=-Y*Y
9845 V=Q :W=S :M=M+I :T=T*U/M :Q=Q+T :M=M+I :T=T/M :S=S+T :
    IF Q<>V OR S<>W GOTO 9845
9846 IF INT(R/2) <> R/2 THEN Q=-Q : S=-S
9847 S=S*Y : TN=S/Q
9848 PRINT "TANGENT OF  " ; X ; "  RADIANS IS  " ; TN
9849 PRINT "ALSO SINE = " ; S ; "  COSINE = " ; Q
9850 PRINT : GOTO 9842                    '  RETURN FOR NEXT ENTRY
9859   '
9860   '  TANGENT ROUTINE, ANGLE IN DEGREES    (ALSO SIN & COS)
9861 DEFDBL P-Y :DEFINT I-N :I=1 :P=180 : PI=3.1415926535897932
9862 INPUT "ENTER ANGLE IN DEGREES FOR TANGENT(X) " ; X
9863 Y=X : R=0 : IF ABS(Y)>P THEN R=FIX(Y/P) : Y=Y-R*P
9864 M=I : Q=I : S=I : T=I : Y=Y*PI/P : U=-Y*Y
9865 V=Q :W=S :M=M+I :T=T*U/M :Q=Q+T :M=M+I :T=T/M :S=S+T :
    IF Q<>V OR S<>W GOTO 9865
9866 IF INT(R/2) <> R/2 THEN Q=-Q : S=-S
9867 S=S*Y : TN=S/Q
9868 PRINT "TANGENT OF  " ; X ; "  DEGREES IS  " ; TN
9869 PRINT "ALSO SINE = " ; S ; "  COSINE = " ; Q
9870 PRINT : GOTO 9862                    '  RETURN FOR NEXT ENTRY
```

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```
9879   '
9880   '  ARCTANGENT ROUTINE, OUTPUT ANGLE IN RADIANS, DEGREES
9881 DEFDBL P-Y :DEFINT I-N : I=1 : J=2 : PI=3.1415926535897932
9882 INPUT "ENTER 'X' FOR ARCTANGENT(X) " ; X
9883 U=X*X : Y=ABS(X) : N=I
9884 IF Y>.77 AND Y<1.18 THEN P=U+I : S=SQR(P) : GOTO 9887
9885 IF U<I THEN R=Y :T=Y :S=-U ELSE T=-I/Y :R=PI/J+T :S=-T*T
9886 V=R :N=N+J :T=T*S :R=R+T/N :IF R<>V GOTO 9886 ELSE 9890
9887 V=S : S=(P/S+S)/J : IF S<>V GOTO 9887   '  ADJUST SQ. ROOT
9888 N=0 : R=Y/S : T=R : U=R*R                '  FOR ARCSINE
9889 V=R :N=N+J :T=T*U*(N-I)/N :R=R+T/(N+I) :IF R<>V GOTO 9889
9890 R=R*SGN(X) : IF DG=1 THEN R=R*180/PI
9891 PRINT "THE ARCTANGENT OF  " ; X ; "  IS  " ; R ;
9892 IF DG=1 PRINT "  DEGREES" ELSE PRINT "  RADIANS"
9893 PRINT : GOTO 9882                        '  RETURN FOR NEXT ENTRY
9899   '
9900   '  ARCTANGENT, OUTPUT IN DEGREES
9901 DG=1 : GOTO 9880
9909   '
9910   '  NATURAL LOGARITHM ROUTINE  (BASE E)
9911 DEFDBL P-Y : DEFINT I-N : I=1 : J=2 : Q=2.7182818284590452
9912 INPUT "ENTER 'X' FOR LN(X) " ; X
9913 IF X<=0 PRINT "**** LN(X) ERROR.  X IS <= ZERO" :GOTO 9912
9914 Y=X : N=I : M=0 : S=I/Q
9915 IF Y>Q THEN Y=Y*S : M=M+I : GOTO 9915    '  SCALE INPUT
9916 IF Y<S THEN Y=Y*Q : M=M-I : GOTO 9916
9917 S=(Y-I)/(Y+I) : W=S : U=S*S
9918 V=S :N=N+J :W=W*U :S=S+W/N :IF S<>V GOTO 9918
9919 S=S*J+M
9920 PRINT "NATURAL LOG OF  " ; X ; "  IS  " ; S
9921 PRINT : GOTO 9912                        '  RETURN FOR NEXT ENTRY
9929   '
9930   '  COMMON LOGARITHM ROUTINE  (BASE 10)
9931 DEFDBL P-Y : DEFINT I-N
9932 I=1 : J=2 : Q=2.7182818284590452 : R=.43429448190325183
9933 INPUT "ENTER 'X' FOR LOG(X) " ; X
9934 IF X<=0 PRINT"**** LOG(X) ERROR.  X IS <= ZERO" :GOTO 9933
9935 Y=X : N=I : M=0 : S=I/Q
9936 IF Y>Q THEN Y=Y*S : M=M+I : GOTO 9936    '  SCALE INPUT
9937 IF Y<S THEN Y=Y*Q : M=M-I : GOTO 9937
9938 S=(Y-I)/(Y+I) : W=S : U=S*S
9939 V=S :N=N+J :W=W*U :S=S+W/N :IF S<>V GOTO 9939
9940 S=S*J+M : S=S*R
9941 PRINT "COMMON LOG OF  " ; X ; "  IS  " ; S
9942 PRINT : GOTO 9933                        '  RETURN FOR NEXT ENTRY
9949   '
9950   '  E[X EXPONENTIAL ROUTINE
9951 DEFDBL P-Y : DEFINT I-N : I=1 : H=86.325
9952 INPUT "ENTER EXPONENT OF 'E' " ; X
9953 Y=ABS(X) :IF Y>H PRINT "**** E[X ERROR.   X>86" :GOTO 9952
9954 S=I+Y : T=Y : N=I : IF Y=0 GOTO 9957
9955 V=S :N=N+I :T=T*Y/N :S=S+T :IF S<>V GOTO 9955
9956 IF X<0 THEN S=I/S
9957 PRINT "E TO THE  " ; X ; "  POWER IS  " ; S
9958 PRINT : GOTO 9952                        '  RETURN FOR NEXT ENTRY
9959   '
9960   '  10[X EXPONENTIAL ROUTINE
9961 DEFDBL P-Y :DEFINT I-N :I=1 :H=37.49 :R=2.3025850929940457
9962 INPUT "ENTER EXPONENT OF 10 " ; X
9963 Y=ABS(X) :IF Y>H PRINT"**** 10[X ERROR.   X>37" :GOTO 9962
9964 Y=Y*R : S=I+Y : T=Y : N=I : IF Y=0 GOTO 9967
9965 V=S :N=N+I :T=T*Y/N :S=S+T :IF S<>V GOTO 9965
9966 IF X<0 THEN S=I/S
9967 PRINT "10 TO THE  " ; X ; "  POWER IS  " ; S
9968 PRINT : GOTO 9962                        '  RETURN FOR NEXT ENTRY
9969   '
9970   '  Y[X POWER ROUTINE
9971 DEFDBL P-Y : DEFINT I-N : I=1 : J=2 : Q=2.7182818284590452
9972 INPUT "ENTER 'Y' AND 'X' FOR Y[X " ; Y, X
9973 IF Y=0 AND X<=0 PRINT"**** Y[X ERROR.  Y=0, X<=0":GOTO 9972
9974 IF Y>0 OR INT(X)=X GOTO 9976
9975 PRINT "**** Y[X ERROR.  Y<0 AND X NOT INTEGER" : GOTO 9972
9976 IF Y=0 THEN R=0 : GOTO 9989
9977 IF X=0 THEN R=I : GOTO 9989
9978 P=ABS(Y) : N=I : M=0 : S=I/Q
9979 IF P>Q THEN P=P*S : M=M+I : GOTO 9979    '  SCALE Y ENTRY
9980 IF P<S THEN P=P*Q : M=M-I : GOTO 9980
9981 S=(P-I)/(P+I) : W=S : U=S*S
9982 V=S :N=N+J :W=W*U :S=S+W/N :IF S<>V GOTO 9982
9983 S=S*J+M : N=I : U=ABS(S*X) : R=U+I : T=U      '  S = LN(Y)
9984 IF U>86.325 PRINT"**** Y[X ERROR.  X TOO LARGE" :GOTO 9972
9985 V=R :N=N+I :T=T*U/N :R=R+T :IF R<>V GOTO 9985
9986 IF Y<0 AND INT(X/J) <> X/J THEN R=-R
9987 IF X<0 THEN R=I/R
9988 IF S<0 THEN R=I/R
9989 PRINT Y ; "  TO THE  " ; X ; "  POWER IS  " ; R
9990 PRINT : GOTO 9972                        '  RETURN FOR NEXT ENTRY
9991 END
```

Most likely, only one or two of these routines would be used in any one of your programs. As an example of how these routines can be used as subroutines, I have written double precision polar-to-rectangular coordinate conversion and rectangular-to-polar coordinate conversion programs shown as Programs B and C.

These math function routines all iterate (repeatedly perform the same set of operations) until further iteration will not change the result. Therefore, they can be used without change for any number of significant digits that your BASIC supports. When used with double precision (16 digits), they normally give a result with 15 to 16 digits precision. The square root routine uses Newton's method of approximation and all of the other routines use Maclaurin's series expansions. Equations used for all routines are listed in Table 1. All of the routines use the input argument of X (except that X and Y are used for the power routine).

The execution time for these double precision routines written in BASIC is, of course, much longer than the built-in assembly language routines and varies with the argument. Maximum execution time is over 10 seconds for some arguments with the arctangent and exponential routines, as these routines may have to iterate 100 to 200 times. The other routines are faster. In any case, it is usually worth the wait to get a more accurate result.

Square Root Routine

The square root routine starts with an initial estimate of the square root then adjusts that estimate to form the next estimate. It continues iterating until successive estimates are equal. In this routine, I have used the single precision square root function SQR to give the initial estimate. If your BASIC does not have a square root function, you may use an initial estimate of one (1). The routine will then have to iterate a little longer but it will still give the same result.

An error message is given if the argument is negative. In these demonstration programs, if an error occurs the program returns to ask for another input. When it is used as a subroutine the routine should probably be modified to halt on error.

Sine Routines

The sine routines for radians or for degrees are the same, except that degrees are converted to radians before calculations. The input angle may have any value, but it is scaled into the range of $\pm\pi$ radians ($\pm 180°$) before calculations. As with the rest of the routines (except square root) the sine routine adds up a series of terms that get smaller and smaller until adding another term makes no difference in the result.

Cosine Routines

The cosine routines are very similar to the sine routines, the main difference being in the starting point for calculation of the terms.

Tangent Routines

The tangent is determined by first calculating both the sine and the cosine, then dividing the sine by the cosine. The routines for radians and for degrees are the same, except that degrees are converted to radians before calculations. Since sine and cosine calculations are so similar, they are done simultaneously with each contributing to the other. These tangent routines give both sine and cosine as byproducts so they may be used

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Table 1. Double Precision Mathematics Equations.

1. Square Root: To approximate $s = \sqrt{x}$

$$s = \frac{\frac{x}{s} + s}{2} \qquad x > 0$$

2. Sine:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots .$$

or:

$$\frac{\sin(x)}{x} = 1 - \frac{x^2}{3!} + \frac{x^4}{5!} - \frac{x^6}{7!} + \ldots .$$

3. Cosine:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots .$$

4. Tangent:

$$\tan(x) = \frac{\sin(x)}{\cos(x)}$$

5. Arctangent:

$$\tan^{-1}(x) = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \ldots . \qquad x^2 < 1$$

$$= \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \ldots . \qquad x^2 > 1$$

$$= \sin^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right) = \sin^{-1}(z) \qquad x^2 \text{ near } 1$$

then:

$$\sin^{-1}(z) = z + \frac{1}{2}\frac{z^3}{3} + \frac{1\cdot3}{2\,4}\frac{z^5}{5} + \frac{1\cdot3\cdot5}{2\,4\,6}\frac{z^7}{7} + \ldots . \qquad z^2 < 1$$

6. Logarithm:

$$\ln(x) = 2\left(\frac{x-1}{x+1} + \frac{1}{3}\left(\frac{x-1}{x+1}\right)^3 + \frac{1}{5}\left(\frac{x-1}{x+1}\right)^5 + \ldots .\right) \qquad x > 0$$

$$\log(x) = \frac{\ln(x)}{\ln(10)}$$

7. Exponential:

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots .$$

$$10^x = e^{(x \ln(10))}$$

8. Power:

$$y^x = e^{(x \ln(y))}$$

Notes:

1) All trigonometric functions are in radian measure.

Degrees = Radians$(180/\pi)$ where $180^0 = \pi$ Radians

2) Factorial is symbolized by "!" that is, 3! means 1 x 2 x 3 = 6

5! means 1 x 2 x 3 x 4 x 5 = 120

etc.

3) Natural logarithm of x = ln(x) logarithm base e, where e = 2.71828

Base 10 logarithm of x = log(x)

where both sine and cosine of the same angle are needed as in polar-to-rectangular conversion (Program B).

Program B. Polar-to-Rectangular Coordinate Conversion.

```
10 CLS : PRINT "POLAR TO RECTANGULAR CONVERSION IN DEGREES"
20 ' BY D. D. HINRICHS IN TRS-80 LEVEL II BASIC
30 DEFDBL P-Y :DEFINT I-N :I=1 :P=180 : PI=3.1415926535897932
40 PRINT : INPUT "ENTER ANGLE IN DEGREES" ; X
50 INPUT "ENTER RADIUS FROM ORIGIN" ; RD
60 GOSUB 9860
70 PRINT "THE 'X' DISTANCE IS " ; RD*Q
80 PRINT "THE 'Y' DISTANCE IS " ; RD*S
90 GOTO 40
100 END
9860 ' TANGENT ROUTINE, ANGLE IN DEGREES (ALSO SIN & COS)
9863 Y=X : R=0 : IF ABS(Y)>P THEN R=FIX(Y/P) : Y=Y-R*P
9864 M=I : Q=I : S=I : T=I : Y=Y*PI/P : U=-Y*Y
9865 V=Q :W=S :M=M+I :T=T*U/M :Q=Q+T :M=M+I :T=T/M :S=S+T :
     IF Q<>V OR S<>W GOTO 9865
9866 IF INT(R/2) <> R/2 THEN Q=-Q : S=-S
9867 S=S*Y : TN=S/Q
9868 RETURN
```

In these routines, **both** sine and cosine must be checked for no change with added terms. If, for example, the angle is near to 90° the sine is near to one while the cosine is near to zero. Thus a term that is not large enough to significantly change the sine may be large enough to change the cosine. If the angle is near to 0°, the situation is reversed.

Arctangent Routines

The arctangent routines for radians or for degrees are actually the same routine, the only difference being in converting the output radians to degrees for the degree routine. This routine actually uses four different series to calculate the arctangent:

1. For arguments less than one the first arctangent series in Table 1.
2. For arguments greater than one the second arctangent series in Table 1.
3. Arguments near to one are calculated too slowly using arctangent routines (1) or (2), so the arctangent is then determined by first applying a trigonometric identity, then using an arcsine series calculation.
4. Using (3) requires use of the square root routine.

Routines for (1) and (2) are similar enough so that with suitable initialization, the same statements may be used. The cutoff points between using (1) and (3), or between using (2) and (3) were chosen to give the minimum calculation time.

Arcsine and arccosine are easily calculated from the arctangent (Table 2, equations 1 and 2). Instead, the arcsine routine may be removed from this arctangent routine and used by itself, and the arccosine calculated from the arcsine (Table 2, equation 3).

Table 2. Trigonometric Identities for Arcsine and Arccosine Calculations.

1. Arcsine:

$$\sin^{-1}(x) = \tan^{-1}\left(\frac{x}{\sqrt{1 - x^2}}\right)$$

2. Arccosine:

$$\cos^{-1}(x) = \tan^{-1}\left(\frac{\sqrt{1 - x^2}}{x}\right)$$

3. Arccosine:

$$\cos^{-1}(x) = \sin^{-1}\left(\sqrt{1 - x^2}\right)$$

Note: The output is in radians. Multiply by $180/\pi$ to get degrees.

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Logarithm Routines

The natural logarithm (ln(X)) and the base 10 logarithm (log(X)) routines are the same, except that the natural logarithm is multiplied by a constant (1/ln(10)) to give the base 10 logarithm. The input argument is scaled, if necessary, so that it falls between 1/e and e (e = 2.71828...). An error message is given if the input argument is zero or negative.

Exponential Routines

The natural exponential (e^X) and the base 10 exponential (10^X) routines are the same, except that the input argument is first multiplied by a constant (ln(10)) if the output is to be for base 10. An error message is given if the absolute value of the input argument is so large that it would cause overflow during calculations (greater than about 86 for natural exponential, or about 37 for base 10 exponential).

Power Routine

The power (y^X) routine makes use of logarithm and exponential routines, similar to the way that you could manually use a table of logarithms to calculate a power. It is most useful when the exponent is not an integer. If the exponent (X) is an integer, it is faster to just multiply the Y value by itself that many times.

Several checks for illegal entries are made and each gives its own error message. This routine requires two entries; if only one entry (Y) is made BASIC will ask for the second (X) with double question marks.

Examples of Use as Subroutines

To show how these routines may be used as subroutines to a main program, I have written two short programs (Programs B and C) to convert double precision coordinates from polar to rectangular and from rectangular to polar. The equations used are given in Table 3. The easiest and most error-free way to write such programs is to load this double precision demonstration program into your computer from tape, then DELETE everything except the routine(s) that you will be using, then write your main program over it.

Program C. Rectangular-to-Polar Coordinate Conversion.

```
10 CLS : PRINT "RECTANGULAR TO POLAR CONVERSION IN DEGREES"
20 DEFDBL P-Y : DEFINT I-N : I=1 : J=2 : PI=3.1415926535897932
30 PRINT : INPUT "ENTER 'X' DISTANCE (+ OR -)" ; XD
40 INPUT "ENTER 'Y' DISTANCE (+ OR -)" ; YD
50 X=XD*XD+YD*YD : GOSUB 9790 : RD=S          ' FIND RADIUS
60 IF XD=0 THEN XD=1D-10                      ' XD CAN'T BE ZERO
70 X=YD/XD : GOSUB 9880 : W=R                 ' FIND ANGLE
80 IF XD<0 THEN W=W+180 : IF YD<0 THEN W=W-360  ' FOR QUADRANT
90 PRINT "RADIUS FROM ORIGIN IS  " ; RD
100 PRINT "ANGLE IS  " ; W ; "  DEGREES"
110 GOTO 30
120 END
9790   ' SQUARE ROOT ROUTINE
9793 S=X : IF X=0 RETURN
9794 IF X<0 PRINT"**** ERROR, SQ. ROOT NEGATIVE NO." : STOP
9795 S=1                                      ' PRELIMINARY VALUE OF SQUARE ROOT
9796 V=S :S=(X/S+S)/J :IF S<>V GOTO 9796      ' ADJUST VALUE
9797 RETURN
9880   ' ARCTANGENT ROUTINE, OUTPUT ANGLE IN DEGREES
9883 U=X*X : Y=ABS(X) : N=I
9884 IF Y>.77 AND Y<1.18 THEN P=U+I : S=1 : GOTO 9887
9885 IF U<I THEN R=Y :T=Y :S=-U ELSE T=-I/Y :R=PI/J+T :S=-T*T
9886 V=R :N=N+J :T=T*S :R=R+T/N :IF R<>V GOTO 9886 ELSE 9890
9887 V=S : S=(P/S+S)/J : IF S<>V GOTO 9887   ' ADJUST SQ. ROOT
9888 N=0 : R=Y/S : T=R : U=R*R               ' FOR ARCSINE
9889 V=R :N=N+J :T=T*U*(N-I)/N :R=R+T/(N+I) :IF R<>V GOTO 9889
9890 R=R*SGN(X) : R=R*180/PI
9891 RETURN
```

Table 3. Polar-to-Rectangular and Rectangular-to-Polar Coordinate Conversion Equations.

1. Polar to Rectangular: where: x, y = Rectangular coordinates

   $x = r \cos(a)$ r, a = Radius & angle of polar coordinates

   $y = r \sin(a)$

2. Rectangular to Polar:

   $r = \sqrt{x^2 + y^2}$

   $a = \tan^{-1}(y/x)$

   For calculation of the proper quadrant for angle "a":

   a) If x = 0, substitute a very small number for x, perhaps 10^{-10}

   b) If $x < 0$, add 180° to a (or add π radians)

   c) If $x < 0$ and $y < 0$, subtract 180° from a (or subtract π radians)

To make it easy to avoid duplicate line numbers when using these routines as subroutines, I have compressed all line numbers for the routines into the 9790 to 9991 range. To convert these demonstration program routines into subroutines:

1. Delete the general initialization line(s) and put this initialization into the main program instead.
2. Delete the INPUT line and set the input argument to X (or to X and Y for the power routine) in the main program before calling the subroutine.
3. Delete the output PRINT statements and save the result as a variable in the main program, after calling the subroutine.
4. Delete the GOTO loop at the end of the routine and replace it with RETURN.
5. I suggest that you replace the GOTO after error messages with either STOP or END to halt program operation if an error occurs. If you do not want the program to halt, replace the GOTO with RETURN.

You must be sure that the subroutine variables do not conflict with variables used in the main program. One way to do this is to use only two-character variables in the main program. The only two-character variables used in the routines are PI and TN.

Compare the listings of the subroutines used in Programs B and C with the listings of the corresponding routines in Program A to see how this conversion to subroutines is done. Note that for the square root subroutine in Program B, and also for the square root routine embedded in the arctangent subroutine in Program C, it is assumed that BASIC does not have a SQR function. The initial guess of the square root is set to one (1).

The output angle for rectangular-to-polar conversion is given in the ±(0° to 180°) convention. The rectangular-to-polar coordinate conversion may fail with an overflow (?OV ERROR IN 9883) if either the X distance or the Y distance is very large or very small. This is most liable to occur if one is large and the other small. For example, if the X distance is zero (then set by the program to 10^{-10}) and the Y distance is 10^{10}, overflow will occur during the calculations.

Precision, con't...

Use with Other BASICs

This set of routines should be easy to translate to BASICs other than the TRS-80 Level II BASIC in which they were written. Following is an explanation of some of the special features used so that you can convert them to equivalent statements in your BASIC. CLS means "clear screen" and is not necessary, but gives a neater CRT display. The colon (:) is used to separate statements in multi-statement lines. The apostrophe (') is an abbreviation of REM. If your BASIC does not have them, the DEFDBL (define double) and the DEFINT (define integer) statements may be eliminated. Of course, if you cannot use double precision variables, you will not get double precision results. Extra program lines and GOTOs may substitute for ELSEs. If you do not have the FIX function, the statement: R = FIX(Y/PI) in line 9803 may be changed to: R = SGN(Y)*INT(ABS (Y)/PI) and similar changes made to all sine, cosine and tangent routines. Also note that in line 9803 and in similar lines in other routines, when the IF statement is false, **none** of the statements following it on the same line are performed. If you do not have a SQR function, set the initial estimate to one (1) in the square root routine and in the arctangent routine (i.e., S = 1).

Conclusions

If you have avoided programming in those areas that require double precision math functions you no longer have an excuse. Accurate interest calculations, satellite orbit analysis and other such problems can now be done. It's up to you! □

Curioser & Curioser

by Sharon H. Nelson

Doctor Leung, Professor
of Computer Science
has
a window in his office.

Plants
are suspended
from the ceiling
before it.

He waters them
carefully
spreads
his hands
in
delicate
oriental
gesture:

But numbers
are only symbols,
the elegance of finer tools, surer hands we
write with after much practice;
like a fine carpenter after many fine houses
we learn our trade

sharpen
our teeth, our pencils, our tongues on
language
not any more like lovers but
calculating
for the smallest advantage.

On his desk there rests
the abacus.

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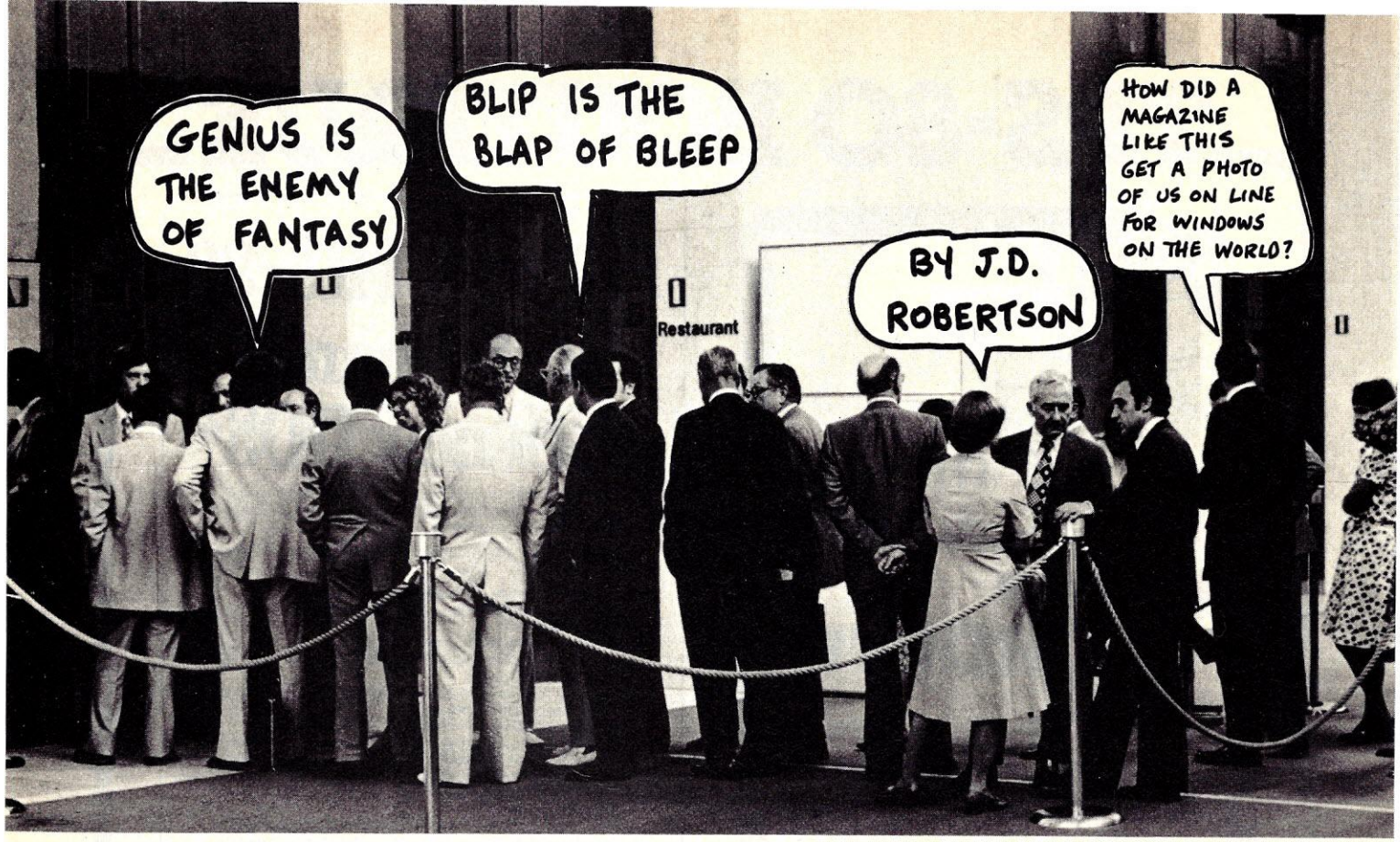
GENIUS IS THE ENEMY OF FANTASY
BLIP IS THE BLAP OF BLEEP
BY J.D. ROBERTSON
HOW DID A MAGAZINE LIKE THIS GET A PHOTO OF US ON LINE FOR WINDOWS ON THE WORLD?
Restaurant

How many times have you been engaged in animated conversation when the person to whom you are talking affronts your ears with an aphoristic banality such as: "NECESSITY IS THE MOTHER OF INVENTION."

Your once complete attention disintegrates into a series of partially stifled yawns. Rather than standing in stunned silence, parry the offending aphorism with one of your own, like: "GENIUS IS THE EUNUCH OF BEAUTY."

Scores of sayings with convoluted meaning can be generated using the program below. You can give new meaning to the phrase, "What did you say?" merely by spouting any one (or several in rapid succession) of the aphorisms created. □

```
10 REM APHORISM GENERATOR
20 REM DR JD ROBERTSON
25 REM JULY 13, 1978
30 REM BLIP IS THE BLAP OF BLEEP
40 DIM X$(25),Y$(25),Z$(25)
41 REM X$/LIST OF BLIP WORDS/
42 REM Y$/LIST OF BLAP WORDS/
43 REM Z$/LIST OF BLEEP WORDS/
50 FOR I=1 TO 25
60 READ X$(I),Y$(I),Z$(I)
70 NEXT I
80 PRINT "HOW MANY APHORISMS WOULD YOU LIKE TO SEE";
85 INPUT N
90 FOR I=1 TO N
95 REM SELECT JTH BLIP WORD, KTH BLAP WORD, AND LTH BLEEP WORD
100 J=1+INT(25*RND(0))
110 K=1+INT(25*RND(0))
120 L=1+INT(25*RND(0))
130 PRINT X$(J);" IS THE ";Y$(K);" OF ";Z$(L);"."
140 NEXT I
145 REM BLIP,BLAP,BLEEP WORDS
150 DATA SANITY,ANATHEMA,LOVE,AGONY,QUAGMIRE,ARDOR
151 DATA DISTRUST,BLIGHT,BEAUTY,POLITICS,HARLOT,HATE
152 DATA GREED,FRIEND,FILTH,GLUTTONY,MOTHER,EVIL
153 DATA HEALTH,FATHER,EXCESS,HYSTERIA,SISTER,FANTASY
154 DATA BREVITY,BROTHER,RACISM,CHARITY,ENEMY,LAUGHTER
155 DATA SECURITY,BANDIT,NAIVETE,SCIENCE,HOUSE,APOPLEXY
156 DATA CELIBACY,KIDNEY,SADISM,DECENCY,HARPY,LUST
157 DATA ABUSE,LAXITIVE,SEX,WEAKNESS,FOLLICLE,LEPROSY
158 DATA BRAVERY,REWARD,DECEIT,GENIUS,GENESIS,LOYALTY
159 DATA DEATH,HEART,SUICIDE,ALCOHOL,LIVER,SUCCESS
160 DATA VIOLENCE,CURATOR,IDIOCY,APATHY,EUNUCH,PROGRESS
161 DATA MONEY,RESULT,FAILURE,GARBAGE,APEX,RELEASE
162 DATA OBESITY,BLADDER,AVARICE
170 END
READY.
```

```
HOW MANY APHORISMS WOULD YOU LIKE TO SEE? 40
AGONY IS THE ENEMY OF FAILURE.
GREED IS THE CURATOR OF PROGRESS.
BRAVERY IS THE BANDIT OF AVARICE.
CELIBACY IS THE HOUSE OF SUCCESS.
HYSTERIA IS THE HEART OF FANTASY.
HEALTH IS THE HARLOT OF FAILURE.
ALCOHOL IS THE ANATHEMA OF EVIL.
VIOLENCE IS THE KIDNEY OF EXCESS.
GLUTTONY IS THE APEX OF RELEASE.
SCIENCE IS THE BANDIT OF SEX.
BREVITY IS THE RESULT OF SUICIDE.
APATHY IS THE ENEMY OF FAILURE.
CHARITY IS THE ENEMY OF BEAUTY.
ALCOHOL IS THE HARLOT OF ARDOR.
SANITY IS THE HOUSE OF HATE.
BREVITY IS THE HARPY OF LOVE.
OBESITY IS THE HARPY OF DECEIT.
BRAVERY IS THE BROTHER OF SEX.
DEATH IS THE GENESIS OF NAIVETE.
DECENCY IS THE FOLLICLE OF RELEASE.
SANITY IS THE EUNUCH OF FAILURE.
GARBAGE IS THE ENEMY OF EXCESS.
AGONY IS THE KIDNEY OF EVIL.
OBESITY IS THE FATHER OF FAILURE.
DECENCY IS THE FOLLICLE OF RELEASE.
BRAVERY IS THE SISTER OF PROGRESS.
AGONY IS THE BLADDER OF APOPLEXY.
CHARITY IS THE HARPY OF RACISM.
GENIUS IS THE HARPY OF PROGRESS.
GLUTTONY IS THE REWARD OF FAILURE.
VIOLENCE IS THE ANATHEMA OF EVIL.
BREVITY IS THE LIVER OF FILTH.
ALCOHOL IS THE BANDIT OF BEAUTY.
GENIUS IS THE CURATOR OF FAILURE.
GENIUS IS THE EUNUCH OF BEAUTY.
SANITY IS THE HOUSE OF LEPROSY.
ABUSE IS THE LAXITIVE OF EVIL.
SECURITY IS THE FOLLICLE OF SUICIDE.
VIOLENCE IS THE FOLLICLE OF FILTH.
MONEY IS THE ENEMY OF FANTASY.
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Dr. J.D. Robertson, QIS Dept., Western Illinois University, Macomb, IL 61455.

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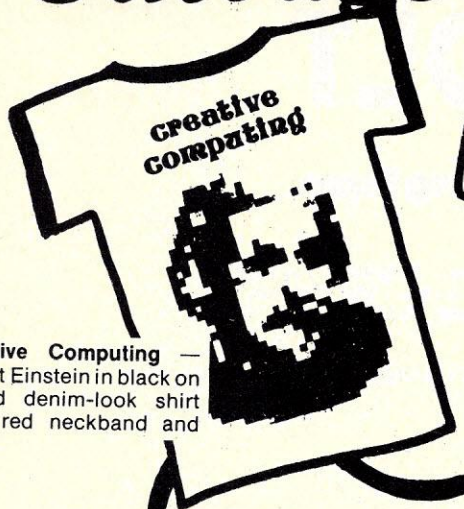

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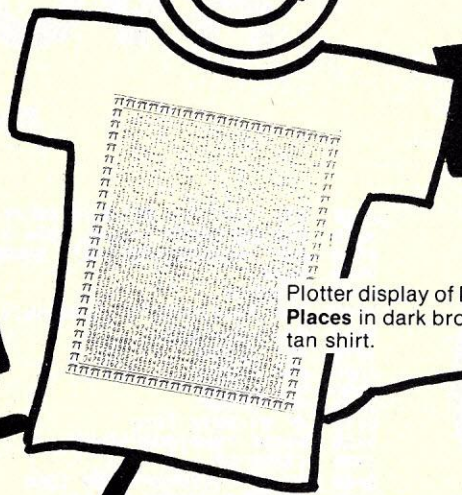

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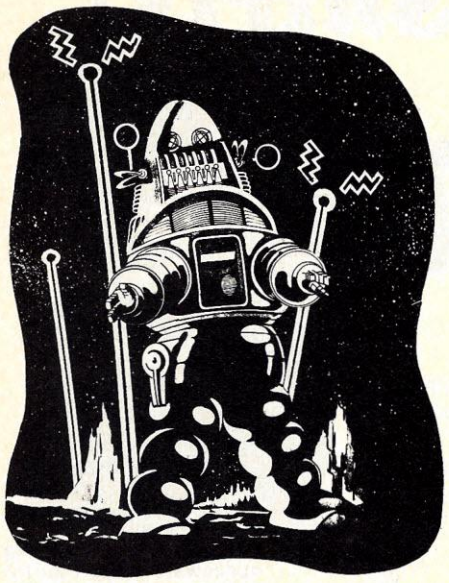


HVOLT

Greg Rappa

The game HVOLT combines a basic board game with the challenge of chess. The player finds himself within a 10 by 20 field surrounded with interceptors, fatal high voltage posts, and offensive attackers. The player is able to move up, down, left, right, and diagonally. Each move advances the player only one space. The interceptors (numbering 15 to 35) are placed arbitrarily throughout the field and they move identically with the moves of the player. Interceptors are destroyed when they hit high voltage posts but cannot pass through an attacker. Therefore, an interceptor will remain stationary when an attacker is in its way. The object of the game is to cause all the interceptors to collide with high voltage posts.

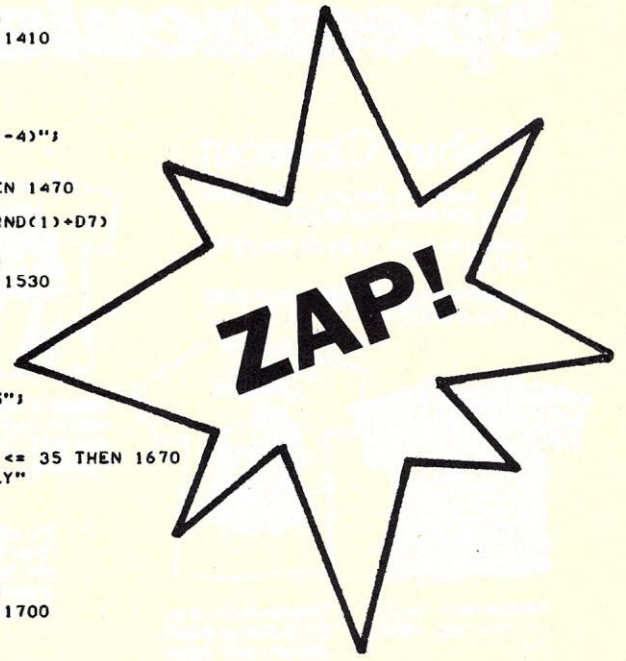
Five types of attackers are also placed randomly upon the field ranging in number from 4 to 6 depending on the desired difficulty. Each type of attacker has a unique form of attack; they strike only when the player is in position to be attacked. The 1 will attack similarly to a chess knight, the 2 attacks in combinations of three and one space combinations, the 3 attacks in four and one space combinations, the 4 attacks in two and three space combinations, and the 5 attacks by four and four space combinations.

A game of difficulty 1 is good for beginners, difficulty 2 and 3 are moderately hard, and difficulty 4 is a challenge!

HVOLT is based on the game **Chase**, which originally appeared in the January 1975 issue of **Creative Computing**.

Greg Rappa, P.O. Box 52, Harrington Park, N.J. 07640.

```
1000  REM "HV0LT", BY GREG RAPPA  DECEMBER 11,1978
1010  REM N0RTHERN VALLEY REG. H.S.,  0LD TAPPAN  NJ
1020  REM TIMESHARING BASIC 2000F SYSTEM
1030  09=0
1040  F6=A8=0
1050  DIM A$[9],B$[72],A[10,20],B[10,20],C[5],D[10,20]
1060  A$=".@*+12345"
1070  MAT A=C0N
1080  MAT D=C0N
1090  MAT B=C0N
1100  MAT C=ZER
1110  IF 09 THEN 1310
1120  PRINT "INSTRUCTI0NS";
1130  INPUT B$
1140  IF B$[1,1]="N" THEN 1310
1150  PRINT ".=EMPTY SPACE        M0VES 0F PLAYER      M0VES 0F ATTACKERS"
1160  PRINT "@=HV P0ST             1.2.3                .3  5"
1170  PRINT "*=PLAYER              4.*.5                .24"
1180  PRINT "+=INTERCEPT0R(15-35)6.7.8                  .1 4"
1190  PRINT "1-5=ATTACKERS(3-6)                         ..123 IN ALL F0UR"
1200  PRINT TAB(40);"*.... DIRECTI0NS"
1210  PRINT
1220  PRINT "INTERCEPT0R'S M0VES ARE IDENTICAL T0 PLAYER'S M0VES. THE"
1230  PRINT "0BJECT 0F THE GAME IS T0 CAUSE ALL THE INTERCEPT0RS T0"
1240  PRINT "C0LLIDE WITH HV P0STS WITH0UT BEING ATTACKED 0R HITTING"
1250  PRINT "AN HV P0ST."
1260  PRINT "ATTACKERS 0NLY ATTACK WHEN PLAYER IS IN P0SITI0N T0 BE "
1270  PRINT "ATTACKED, THEN THE GAME IS 0VER."
1280  PRINT "INTERCEPT0RS CAN N0T M0VE INT0 AN ATTACKER."
1290  PRINT "DIFFICULTY 1, EASY... DIFFICULTY 4, CHALLENGING!"
1300  PRINT LIN(2)
1310  F0R A1=1 T0 10
1320  IF A1>1 AND A1<10 THEN 1360
1330  F0R A2=1 T0 20
1340  A[10,A2]=A[1,A2]=2
1350  NEXT A2
1360  A[A1,1]=A[A1,20]=2
1370  NEXT A1
1380  F0R A7=2 T0 9
1390  A4=INT(4*RND(1)+1)
1400  F0R A5=1 T0 A4
1410  A6=INT(20*RND(1)+1)
1420  IF A[A7,A6]#1 THEN 1410
1430  A[A7,A6]=2
1440  A8=A8+1
1450  NEXT A5
1460  NEXT A7
1470  PRINT "DIFFICULTY(1-4)";
1480  INPUT D7
1490  D7=INT(D7)
1500  IF D7<1 0R D7>4 THEN 1470
1510  F0R P9=5 T0 9
1520  F0R P8=1 T0 INT(3*RND(1)+D7)
1530  R1=INT(8*RND(1)+2)
1540  R2=INT(18*RND(1)+2)
1550  IF A[R1,R2]#1 THEN 1530
1560  A[R1,R2]=P9
1570  C[P9-4]=C[P9-4]+1
1580  NEXT P8
1590  C[P9-4]=P8-1
1600  NEXT P9
1610  PRINT "INTERCEPT0RS";
1620  INPUT B9
1630  B9=INT(B9)
1640  IF B9 >= 15 AND B9 <= 35 THEN 1670
1650  PRINT "15 T0 35 0NLY"
1660  G0T0 1610
1670  PRINT LIN(2)
1680  R1=R8=B9
1690  F0R B1=1 T0 B9
1700  B2=INT(8*RND(1)+2)
1710  B3=INT(18*RND(1)+2)
1720  IF A[B2,B3]#1 THEN 1700
1730  A[B2,B3]=4
1740  NEXT B1
1750  B4=INT(8*RND(1)+2)
1760  B5=INT(18*RND(1)+2)
1770  IF A[B4,B5]#1 THEN 1750
1780  A[B4,B5]=3
1790  MAT D=A
1800  MAT B=A
```



```
1810  PRINT  USING 1820;R1,A8,D7,C(1),C(2),C(3),C(4),C(5)
1820  IMAGE 2D,"!",2D,"!",D,"!",D,X,D,X,D,X,D,X,D
1830  IF B9>0 THEN 1890
1840  PRINT "Y0U'VE W0N THE GAME"
1850  PRINT "AND HAVE DESTR0YED"
1860  PRINT  USING 1870;R1,F6
1870  IMAGE 2D," INTS IN ",2D," M0VES"
1880  G0T0 2660
1890  F6=F6+1
1900  F0R D=1 T0 10
1910  F0R D1=1 T0 20
1920  PRINT A$(A(D,D1),A(D,D1));
1930  NEXT D1
1940  PRINT
1950  NEXT D
1960  RESTØRE 2010
1970  PRINT "M0VE";
1980  INPUT M
1990  M=INT(M)
2000  IF M <= 0 0R M >= 9 THEN 1970
2010  DATA -1,-1,-1,0,-1,1,0,-1,0,1,1,-1,1,0,1,1
2020  F0R N1=1 T0 M
2030  READ N,P
2040  NEXT N1
2050  T1=T7=2
2060  T4=1
2070  T2=9
2080  T3=19
2090  IF M <= 4 THEN 2140
2100  T4=-1
2110  T2=T3=1
2120  T7=19
2130  T1=9
2140  F0R P1=T1 T0 T2 STEP T4
2150  F0R P2=T7 T0 T3 STEP T4
2160  G0T0 A(P1,P2) 0F 2450,2450,2170,2390,2450,2450,2450,2450,2450
2170  R5=P1
2180  R6=P2
2190  IF A(P1+N,P2+P)<5 THEN 2220
2200  PRINT "Y0U HIT AN ATTACKER!"
2210  G0T0 2640
2220  IF A(P1+N,P2+P)#2 THEN 2270
2230  PRINT "Y0U HAVE HIT AN HV"
2240  PRINT "P0ST AND RECEIVE"
2250  PRINT "10,000 V0LTS!"
2260  G0T0 2640
2270  IF A(P1+N,P2+P)=4 THEN 2290
2280  G0T0 2360
2290  PRINT "IMP0SSIBLE M0VE!"
2300  PRINT "INTERCEPT0R CANN0T"
2310  PRINT "M0VE IN THIS CASE"
2320  MAT A=D
2330  MAT B=D
2340  B9=R8
2350  G0T0 1960
2360  B(P1+N,P2+P)=3
2370  B(P1,P2)=A(P1,P2)=1
2380  G0T0 2450
2390  IF A(P1+N,P2+P) >= 4 THEN 2450
2400  IF A(P1+N,P2+P)#2 THEN 2430
2410  B9=B9-1
2420  G0T0 2440
2430  B(P1+N,P2+P)=4
2440  B(P1,P2)=A(P1,P2)=1
2450  NEXT P2
2460  NEXT P1
2470  MAT A=B
2480  MAT D=B
2490  RESTØRE 2720
2500  F0R C8=1 T0 5
2510  F0R C9=1 T0 8
2520  READ N4,P4
2530  G1=R5+N+N4
2540  G2=R6+P+P4
2550  IF G1 >= 1 AND G1 <= 10 AND G2 >= 1 AND G2 <= 20 THEN 2570
2560  G0T0 2580
2570  IF A(R5+N+N4,R6+P+P4)=C8+4 THEN 2620
2580  NEXT C9
2590  NEXT C8
2600  R8=B9
2610  G0T0 1830
2620  PRINT  USING 2630;C8,R5+N+N4,R6+P+P4
2630  IMAGE D," FR0M ",D,",",2D," ATTACKS"
2640  PRINT "THE GAME IS 0VER"
2650  PRINT "AND Y0U'VE L0ST!"
2660  PRINT "**AN0THER GAME";
2670  INPUT B$
2680  IF B$(1,1)="N" THEN 2770
2690  G9=1
2700  PRINT LIN(4)
2710  G0T0 1040
2720  DATA -2,-1,-2,1,-1,-2,-1,2,2,-1,2,1,1,-2,1,2
2730  DATA -3,-1,-3,1,-1,-3,-1,3,3,-1,3,1,1,-3,1,3
2740  DATA -4,-1,-4,1,-1,-4,-1,4,4,-1,4,1,1,-4,1,4
2750  DATA -3,-2,-3,2,-2,-3,-2,3,3,-2,3,2,2,-3,2,3
2760  DATA -4,-4,-4,4,4,4,4,-4,-4,-4,-4,4,4,4,4,-4
2770  END
```

```
RUN
HVOLT

INSTRUCTIONS?Y
.=EMPTY SPACE          MOVES OF PLAYER      MOVES OF ATTACKERS
@=HV POST              1 2 3                 3   5
*=PLAYER               4 * 5                 2 4
+=INTERCEPTOR(15-35)   6 7 8                 1   4
1-5=ATTACKERS(3-6)                           123 IN ALL FOUR
                                             **** DIRECTIONS

INTERCEPTOR'S MOVES ARE IDENTICAL TO PLAYER'S MOVES. THE
OBJECT OF THE GAME IS TO CAUSE ALL THE INTERCEPTORS TO
COLLIDE WITH HV POSTS WITHOUT BEING ATTACKED OR HITTING
AN HV POST.
ATTACKERS ONLY ATTACK WHEN PLAYER IS IN POSITION TO BE
ATTACKED, THEN THE GAME IS OVER.
INTERCEPTORS CAN NOT MOVE INTO AN ATTACKER.
DIFFICULTY 1, EASY... DIFFICULTY 4, CHALLENGING!

DIFFICULTY(1-4)?1
INTERCEPTORS?15

 15:16:1:1  2 2 2 2
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@....+@
@....*....@.++..3..@
@..5@.@...+.......5@
@....@+.......@+..+@
@.........+...2...@.@
@....1..@...++@@34.@
@...@...4..@+.@2+.@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?5
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+......5@
@....@.+......@.+..@
@.........+..2...@.@
@....1..@....+@@34.@
@...@...4..@.+@2.+@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?5
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+..+.@.@
@.........@..@.....@
@......*..@...++3..@
@..5@.@...+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?4
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+......5@
@....@.+......@.+..@
@.........+..2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?4
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+......5@
@....@.+......@.+..@
@.........+..2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?2
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@....*....@.+@.....@
@.........@.....3..@
@..50.@.........+..5@
@....@.....+...@....@
@.....@.....2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?5
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+......5@
@....@.+......@.+..@
@.........+..2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?5
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?4
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?4
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?2
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@....*....@.+@.....@
@.........@.....3..@
@..50.@.........+..5@
@....@.....+...@....@
@.....@.....2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?5
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?7
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@.....@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?7
@@@@@@@@@@@@@@@@@@@@@
@.....+...+..+...@.@
@.........@..@.....@
@.....*...@..++.3..@
@..5@.@....+.....5@
@....@..+.....@..+.@
@..........+.2...@.@
@....1..@..+..@@34.@
@...@...4..@..@2..@@
@@@@@@@@@@@@@@@@@@@@@
MOVE?7
YOU'VE WON THE GAME
AND HAVE DESTROYED
15 INTS IN 10 MOVES
**ANOTHER GAME?N

DONE
```

Another new game from Creative Computing ....

FORT

D. Stanley, D. Butlien, S. Cohen

```
 RUN
DO YOU NEED INSTRUCTIONS?(1=YES 2=NO)? 1

                    INSTRUCTIONS FOR :

                       ****** FORT ******


YOU ARE THE GENERAL OF F-TROOP AND THE HECKAWEES
INDIANS ARE ON THE WARPATH.YOU MUST HOLD THE FORT FOR 3
DAYS(10 COMMANDS) IN ORDER FOR THE SEVENTEENTH CAVALRY TO ARRIVE WITH
RE-INFORCEMENTS TO SAVE THE WEST FROM THE INDIANS.
THERE ARE 1600 INDIANS SPLIT UP SO THAT 400 INDIANS ARE ON
EACH SIDE.YOU HAVE 120 MEN PLACED SO THAT THERE ARE 30
MEN ON EACH SIDE.THERE IS ONE CANNON PER SIDE AND EACH HAS
5 CANNON BALLS.YOU ALSO START WITH 2300 ROUNDS OF AMMO.

YOUR COMMANDS ARE:

(1)             THIS COMMAND ALLOWS YOU TO ATTACK
                THE INDIANS.IN A SINGLE TURN YOU MAY ATTACK 1-4
                SIDES WITH EITHER RIFFLES OR CANNONS.YOU MAY NOT
                THE SAME SIDE MORE THAN ONCE DURING AN ATTACK.

(2)             THIS COMMAND ALLOWS YOU TO MOVE MENOR
                CANNON BALLS FROM ONE SIDE TO ANOTHER.
                REMEMBER WHEN YOU MOVE YOUR MEN THE INDIANS ARE
                GOING TO MOVE CLOSER TO THE FORT.

(3)             THIS COMMAND ALLOWS YOU TO GET A STATUS REPORT
                WHICH SHOWS THE NUMBER OF INDIANS,MEN,AND
                CANNON BALLS,AS WELL AS THEIR LOCATIONS.
                IT ALSO SHOWS:
                THE DISTANCE THE INDIANS ARE AWAY FROM THE FORT AND
                THE AMMOUNT OF AMMUNITION LEFT.
                THIS DOES NOT USE UP ANY OF YOUR 10 COMMANDS.

(4)             THIS COMMAND ALLOWS YOU TO SURRENDER.

(5)             THIS COMMAND ALLOWS YOU TO START A NEW GAME.

(6)             THIS COMMAND PRINTS A CONCISE LIST OF COMMANDS
                THIS ALSO DOES NOT USE UP ANY COMMANDS.


 WHAT IS YOUR LAST NAME????????? JOHN DOE

 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 6
(1) ATTACK
(2) MOVE MEN/CANNONBALLS
(3) STATUS REPORT
(4) SURRENDER
(5) NEW GAME
(6) LIST OF COMMANDS

 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 3
```

FORT is written in a dialect of DEC BASIC. See the program for instructions. The program should be converted to other machines fairly easily. Note that the multiple statement separator in this code is a backslash - most other computers use colons. Also, IF — THEN statements in this BASIC go to the next statement, while Microsoft BASICs go to the next line. (So split up multiple statements into separate lines.)

D. Stanley, D. Butlien, S. Cohen, 32 Lambert Lane, New Rochelle, NY.

```
 S T A T U S   R E P O R T

SIDE#        # OF INDIANS              #OF MEN        # OF CANNON BALLS
 1            400                       30             5
 2            400                       30             5
 3            400                       30             5
 4            400                       30             5

TOTALS        1600                      120            20


YOU HAVE:
        2300 BULLETS
    AND 3 DAYS LEFT


                              150
                              400
                 ****************************************
                 *                30                    *
                 *                                      *
                 *                                      *
           150   *                                      *   150
           400   *   30          F-TROOP          30     *   400
                 *                                      *
                 *                                      *
                 *                30                    *
                 ****************************************
                              400
                              150

 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 1


HOW MANY SIDES DO YOU WANT TO ATTACK? 2
THIS IS ATTACK NO. 1
CANNON(1) OR(2) RIFLES? 1
 WHICH CANNON? 1
 HOW MANY CANNON BALLS? 4
 THOSE SHOTS KILLED 60 INDIANS


THIS IS ATTACK NO. 2
CANNON(1) OR(2) RIFLES? 2
WHICH SIDE? 2
HOW MANY ROUNDS? 310
YOU DON'T HAVE THAT MANY ROUNDS
HOW MANY ROUNDS? 300
 YOU HAVE KILLED 206  INDIANS


SIDE NO. 1  LOST  7  MEN
THE INDIANS ARE  94  FEET AWAY FROM THE FORT

SIDE NO. 2  LOST  11  MEN
THE INDIANS ARE  102  FEET AWAY FROM THE FORT

SIDE NO. 3  LOST  6  MEN
THE INDIANS ARE  102  FEET AWAY FROM THE FORT

SIDE NO. 4  LOST  15  MEN
THE INDIANS ARE  30  FEET AWAY FROM THE FORT


 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 3
```

```
 S T A T U S   R E P O R T

SIDE#        # OF INDIANS              #OF MEN        # OF CANNON BALLS
 1            340                       23             1
 2            194                       19             5
 3            400                       24             5
 4            400                       15             5

TOTALS        1334                      81             16


YOU HAVE:
        2000 BULLETS
    AND 2.7 DAYS LEFT


                              94
                              340
                 ****************************************
                 *                23                    *
                 *                                      *
                 *                                      *
           102   *                                      *   30
           194   *   19          F-TROOP          15     *   400
                 *                                      *
                 *                                      *
                 *                24                    *
                 ****************************************
                              400
                              102

 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 2


 DO YOU WHAT TO MOVE MEN(1) OR CANNONBALLS(2)? 1
 HOW MANY MEN? 5
FROM WHERE? 1
TO WHERE? 4
 SIDE 1  NOW HAS 18 MEN AND
 SIDE 4 NOW HAS  20 MEN

 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 2


 DO YOU WHAT TO MOVE MEN(1) OR CANNONBALLS(2)? 2
FROM CANNON? 3
 TO CANNON? 1
 HOW MANY BALLS? 2

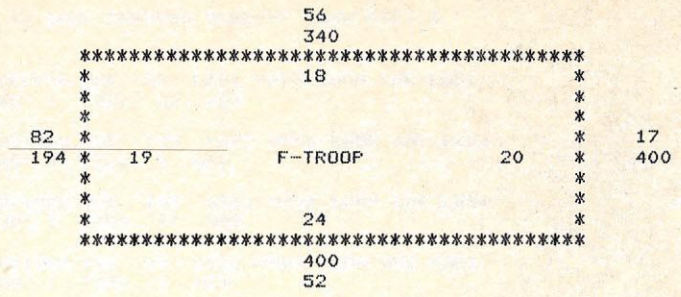
 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 3


 S T A T U S   R E P O R T

SIDE#        # OF INDIANS              #OF MEN        # OF CANNON BALLS
 1            340                       18             3
 2            194                       19             5
 3            400                       24             3
 4            400                       20             5

TOTALS        1334                      81             16


YOU HAVE:
        2000 BULLETS
    AND 1.8 DAYS LEFT
```




```
 WHAT IS YOUR COMMAND GENERAL JOHN DOE? 4
YOU YELLOW BELLIED SAP SUCKER!!!!!!!
THE INDIANS HAVE TAKEN OVER THE FORT
AND YOU HAVE GIVEN THEM A CHANCE TO TAKE OVER THE WEST.



  P.S. YOU HAVE BEEN SCALPED
```

```
  1 RANDOMIZE
  3 REM                          FORT
  5 REM    WRITTEN BY:
  6 REM
  7 REM  SETH A. COHEN                          DAVID L. BUTLIEN
  8 REM                      DAVID E. STANLEY
  9 REM  FEBRUARY, 1979 AT NEW ROCHELLE HIGH SCHOOL, NEW ROCHELLE, N.Y.

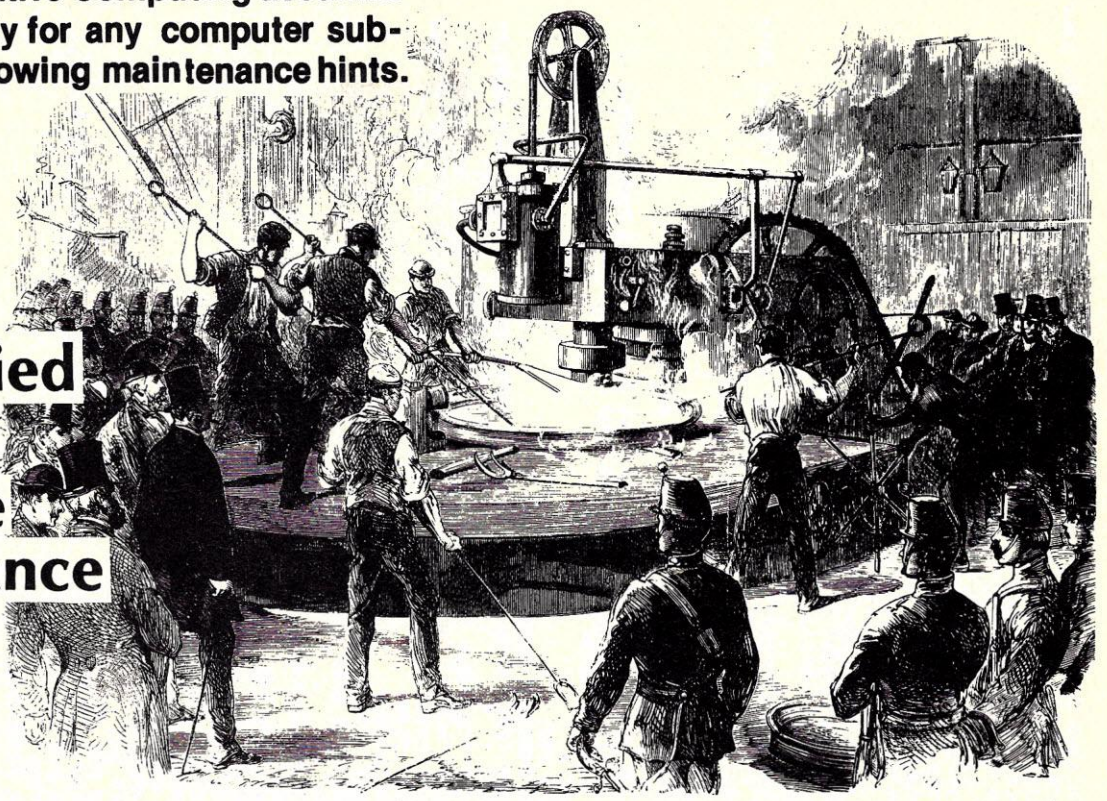
 10 M=140\I=1600\C=4\D=3\B=2300\C(1)=5\C(2)=5\C(3)=5\C(4)=5\C1=20
 15 M(1)=30\M(2)=30\M(3)=30\M(4)=30\I(1)=400\I(2)=400\I(3)=400
 20 I(4)=400\F(1)=150\F(2)=150\F(3)=150\F(4)=150
 25 PRINTCHR$(12)

 30 INPUT" DO YOU NEED INSTRUCTIONS?(1=YES 2=NO)"B
 32 PRINT\PRINT
 35 IF B=2 THEN 195
 40 PRINTTAB(20)" INSTRUCTIONS FOR :"
 45 PRINT\PRINTTAB(25)"****** FORT ******"
 50 PRINT\PRINT\PRINT
 55 PRINT" YOU ARE THE GENERAL OF F-TROOP AND THE HECKAWEES"
 60 PRINT" INDIANS ARE ON THE WARPATH.YOU MUST HOLD THE FORT FOR 3"
 65 PRINT" DAYS(10 COMMANDS)";
 70 PRINT" IN ORDER FOR THE SEVENTEENTH CAVALRY TO ARRIVE WITH"
 75 PRINT" RE-INFORCEMENTS TO SAVE THE WEST FROM THE INDIANS."
 80 PRINT" THERE ARE 1600 INDIANS SPLIT UP SO THAT 400 INDIANS ARE ON"
 85 PRINT" EACH SIDE.YOU HAVE 120 MEN PLACED SO THAT THERE ARE 30"
 90 PRINT" MEN ON EACH SIDE.THERE IS ONE CANNON PER SIDE AND EACH HAS"
 95 PRINT" 5 CANNON BALLS.YOU ALSO START WITH 2300 ROUNDS OF AMMO."
100 PRINT\PRINT" YOUR COMMANDS ARE:"
105 PRINT\PRINT"(1)"TAB(19)"THIS COMMAND ALLOWS YOU TO ATTACK"
110 PRINTTAB(19)"THE INDIANS.IN A SINGLE TURN YOU MAY ATTACK 1-4"
115 PRINTTAB(19)"SIDES WITH EITHER RIFFLES OR CANNONS.YOU MAY NOT"
120 PRINT TAB(19)"THE SAME SIDE MORE THAN ONCE DURING AN ATTACK."
125 PRINT
130 PRINT"(2)"TAB(19)"THIS COMMAND ALLOWS YOU TO MOVE MENOR"
135 PRINTTAB(19)"CANNON BALLS FROM ONE SIDE TO ANOTHER."
140 PRINTTAB(19)"REMEMBER WHEN YOU MOVE YOUR MEN THE INDIANS ARE"
145 PRINTTAB(19)"GOING TO MOVE CLOSER TO THE FORT"
150 PRINT
155 PRINT"(3)"TAB(19)"THIS COMMAND ALLOWS YOU TO GET A STATUS REPORT"
160 PRINTTAB(19)"WHICH SHOWS THE NUMBER OF INDIANS,MEN,AND"
165 PRINTTAB(19)"CANNON BALLS,AS WELL AS THEIR LOCATIONS."
170 PRINTTAB(19)"IT ALSO SHOWS:"
175 PRINTTAB(19)"THE DISTANCE THE INDIANS ARE AWAY FROM THE FORT AND"
180 PRINTTAB(19)"THE AMMOUNT OF AMMUNITION LEFT."
183 PRINTTAB(19)"THIS DOES NOT USE UP ANY OF YOUR 10 COMMANDS."
185 PRINT\PRINT"(4)"TAB(19)"THIS COMMAND ALLOWS YOU TO SURRENDER"
186 PRINT
187 PRINT"(5)"TAB(19)"THIS COMMAND ALLOWS YOU TO START A NEW GAME"
188 PRINT
189 PRINT"(6)"TAB(19)"THIS COMMAND PRINTS A CONCISE LIST OF COMMANDS"
190 PRINT TAB(19)"THIS ALSO DOES NOT USE UP ANY COMMANDS."

195 PRINT" WHAT IS YOUR LAST NAME????????";
200 LINPUTA$
205 PRINT\IF I(1)+I(2)+I(3)+I(4)<1 THEN 1620
210 PRINT" WHAT IS YOUR COMMAND GENERAL "A$(1);A$(2);
220 INPUTS\D=INT(10*(D-.3))/10\IF S<>3 THEN IF D=0 THEN 1520
225 FOR X=1 TO 4\T5(X)=0\NEXTX
230 ON S GOTO 300,500,700,1800,1750,1850
240 REM 1=ATTACK  2=MOVE     3=STATUS
300 REM FOR ATTACK
305 PRINT\PRINT
306 INPUT"HOW MANY SIDES DO YOU WANT TO ATTACK"P\IF P>4 THEN1190
308 FOR Q=1 TO P
309 PRINT"THIS IS ATTACK NO."Q
310 PRINT"CANNON(1) OR(2) RIFLES";\INPUTA\IF A=0 THEN 205
320 IF A=2THEN400
325 REM FOR CANNON ATTACK
330 PRINT" WHICH CANNON";\INPUTC2\IF C2=0THEN 309\IF C(C2)=0 THEN395
335 IF M(C2)=0 THEN398
340 PRINT" HOW MANY CANNON BALLS";\INPUTK1\IF K1=0 THEN 309
345 IF C(C2)<K1 THENPRINT"YOU DONT HAVE THAT MANY"
347 IF C(C2)<K1 THEN340
350 REM 1 CANNON BALL KILLS 15 INDIANS
353 K(Q)=15*K1
355 IF I(C2)<0 THEN I(C2)=0\IF I(C2)-K(Q)<0 THEN K(Q)=I(C2)
360 C(C2)=C(C2)-K1\I=I-K(Q)\I(C2)=I(C2)-K(Q)\C1=C1-K1
380 PRINT" THOSE SHOTS KILLED"K(Q)"INDIANS"\PRINT\PRINT
390 GOTO 470
395 PRINT"YOU DON'T HAVE ANY CANNON BALLS LEFT ON THAT SIDE"
397 GOTO 470
398 PRINT"YOU DON'T HAVE ANY BODY ON THAT SIDE TO FIRE"
399 GOTO 470
400 REM FOR RIFLES
410 INPUT"WHICH SIDE"S1\IFS1=0THEN205\T5(S1)=T5(S1)+1
411 IF T5(S1)=2 THEN 1170
420 INP"HOW MANY ROUNDS"R\X=M(S1)*10\IF R>XTHEN1200
425 IF R>B THEN 1205\B=B-R
430 K(Q)=INT(RND(0)*(.8*R))+1\IFK(Q)>I(S1)THENK(Q)=I(S1)
440 IF K(Q)<R/2THEN 430
450 I(S1)=I(S1)-K(Q)
460 PRINT" YOU HAVE KILLED"K(Q)" INDIANS"\PRINT\PRINT
465 IF I(1)+I(2)+I(3)+I(4)=0 THEN1620
470 NEXTQ
480 GOTO 1210
500 REM TO MOVE MEN
505 PRINT\PRINT
510 INPUT" DO YOU WHAT TO MOVE MEN(1) OR CANNONBALLS(2)"M
515 IF M=0 THEN 205
520 IF M=2THEN 600
530 INPUT" HOW MANY MEN"N
535 IF N=0 THEN205\D=D-.3
540 INPUT"FROM WHERE"S1\INPUT"TO WHERE"S2\IFS1=0THEN205\IFS2=0THEN205
```

```
543 IF M(S1)<N THENPRINT" YOU DONT HAVE THAT MANY MEN"
545 IF M(S1)<N THEN  530
550 M(S1)=M(S1)-N\M(S2)=M(S2)+N
560 PRINT " SIDE"S1" NOW HAS"M(S1)"MEN AND"
570 PRINT" SIDE"S2"NOW HAS "M(S2)"MEN"
580 GOTO 1700
599 REM TO MOVE CANNONBALLS
600 INPUT "FROM CANNON"C2\INPUT " TO CANNON"C3\IFC2=0THEN205
605 IF C3=0 THEN 205
610 INPUT " HOW MANY BALLS"X\IF X=0THEN205
620 IFX>C(C2)THEN PRINT "THERE ARE ONLY"C(C2)"BALLS THERE"
630 IF X>C(C2)THEN 610
640 C(C2)=C(C2)-X
650 C(C3)=C(C3)+X
660 GOTO 205
700 REM FOR STATUS
705 IF D<>3THEN D=D+.3
706 PRINT\PRINT
707 PRINT" S T A T U S  R E P O R T"\PRINT
710 PRINT "SIDE#","# OF INDIANS",,"#OF MEN"," # OF CANNON BALLS"
712 I=I(1)+I(2)+I(3)+I(4)
715 M=M(1)+M(2)+M(3)+M(4)\FOR X=1 TO 4\IF I(X)<1THEN F(X)=0
717 NEXT X
720 FOR X=1TO4
730 PRINT X,I(X),,M(X),C(X)\NEX X
740 PRINT\PRINT "TOTALS",I,,M,C1
750 PRINT\PRINT\PRINT"YOU HAVE:"
760 PRINT TAB(7)B"BULLETS"\PRINT TAB(4)"AND"D"DAYS LEFT"
763 REM:  PRINTS LAYOUT OF THE FORT
765 PRINT\PRINT\PRINT\PRINT TAB(32)$F(1)
770 PRINT TAB(32)I(1)
780 PRINT TAB(15)$\FOR X=1TO41\PRINT "*"$\NEXT X
785 PRINT
790 PRINT TAB(15)"*"$TAB(32)M(1)$TAB(55)"*"
795 FOR X=1 TO 2
800 PRINT TAB(15)"*"TAB(55)"*"
810 NEXT X
815 PRINT TAB(10)F(2)$TAB(15)"*"$TAB(55)"*"$TAB(59)F(4)
820 PRINT TAB(10)$I(2)$TAB(15)"*  "$M(2)$TAB(31)"F-TROOP"$
825 PRINT TAB(48)M(4)$TAB(55)"*"$TAB(59)I(4)
830 FOR X=1TO2\PRINT TAB(15)"*"TAB(55)"*"\ NEXT X
840 PRINT TAB(15)"*"$TAB(32)M(3)$TAB(55)"*"
850 PRINT TAB(15)$\FOR X=1TO41\PRINT "*"$\NEXT X
855 PRINT
860 PRINT TAB(32)I(3)
865 PRINT TAB(32)F(3)
870 GOTO 205
1170 PRINT " YOU ALREADY SHOT ON THAT SIDE"\GOTO 410
1190 PRINT "YOU CAN'T ATTACK THAT MANY SIDES"\GOTO 306
1200 PRINT "YOU DON'T HAVE THAT MANY ROUNDS"\GOTO 420
1205 PRINT " YOU DON'T HAVE THAT MANY BULLETS LEFT"\GOTO 410
1210 REM FOR INDIAN ATTACK
1215 FOR X=1 TO 4
1217 IF M(X)=0 THEN 1285\IF I(X)<1 THEN 1495
1220 O=INT(I(X)/M(X))
1230 S3(X)=INT(RND(0)*O)+1
1240 S3(X)=INT(S3(X)+5)
1250 IF S3(X)=1 THEN S3(X)=0\IF S3(X)>M(X)THEN S3(X)=M(X)
1260 PRINT "SIDE NO."X$
1265 IF M(X)>0 THEN PRINT " LOST "S3(X)" MEN"
1270 M(X)=M(X)-S3(X)
1280 IF M(X)<0 THEN M(X)=0
1285 IF M(1)+M(2)+M(3)+M(4)<1 THEN 1590\IF I(X)<1 THEN 1495
1290 F5=S3(X)*8\IF K(X)>150 THEN F(X)=F(X)+40\F(X)=F(X)-F5
1295 H=INT(RND(0)*50)+1
1296 IF I(X)<1 THEN 1496
1297 IFM(X)=0 THEN F(X)=F(X)-H\IF I(X)<1 THEN F(X)=0\IF F(X)<0THEN 1300
1298 GOTO  1485
1300 PRINT " THE INDIANS ARE COMING INTO THE FORT ON SIDE"X"!!!"
1310 P=INT(RND(0)*M(X))+1
1320 M(X)=M(X)-P\I(X)=I(X)-(P*2)
1330 IF I(X)<15THEN 1400
1350 M(X)=0\PRINT " ALL THE MEN ON SIDE"X" HAVE BEEN KILLED"
1360 PRINT " THERE ARE"I(X)" INDIANS IN THE FORT"
1370 P=INT(RND(0)*I(X))+1\P=P*.5\P=P/4
1380 FOR T=1 TO 4\M(T)=INT(M(T)-P)
1385 IF M(T)<0THEN M(T)=0\NEXT T
1387 IF M(1)+M(2)+M(3)+M(4)=0 THE 1600
1390 FOR T=1TO4\PRINT " THERE ARE NOW"M(T)" MEN ON SIDE "T
1393 IFM(1)+M(2)+M(3)+M(4)=0 THEN 1600
1395 NEXT T
1400 I(X)=I(X)-10\PRINT " THE INDIANS ON SIDE"X" HAVE BEEN PUSHED OUT"
1405 IF I(X)<0THEN  I(X)=0
1410 PRINT " THERE "I(X)" INDIANS ON THAT SIDE"\F(X)=150
1413 IF F(X)<1 THEN F(X)=0
1415 GOTO 1485
1420 PRINT " THE INDIANS HAVE COME IN ON SIDE "X
1485 IF I(X)<1 THEN F(X)=0
1490 PRINT "THE INDIANS ARE "F(X)" FEET AWAY FROM THE FORT"\PRINT
1492 IF I(1)+I(2)+I(3)+I(4)<1 THEN 1620
1495 IF P1=2 THEN1730
1500 NEXT X
1507 GOTO 205
1510 REM POSSIBLE ENDING
1520 PRINT "WAIT A MINUTE.....HERE COMES THE CAVALRY TO THE RESCUE"
1530 PRINT "          H H H U U U R R R A A A Y Y Y"\PRINT
1540 PRINT "YOU HELD THE FORT FROM THE INDIANS AND SAVED THE WEST"
1550 PRINT "NOW ALL MEN CAN LIVE IN PEACE,HARMONY,LOVE,AND BROTHERHOOD"
1560 PRINT\PRINT\PRINT "                                        A M E N"
1580 GOTO  2046
1590 PRINT\PRINT
1600 PRINT CHR$(12)\PRINT "YOU LOST ALL YOUR MEN"
1610 PRINT "GO TAKE A SHOWER"
1615 STOP
1620 PRINT "YOU KILLED ALL THE INDIANS "\GOTO 1530
1630 STOP
1699 REM DETERMINES DISTANCE OF INDIANS
1700 FOR X=1 TO 4
1710 H=INT(RND(0)*50)+1
1720 F(X)=F(X)-H
1722 P1=2\IF I(X)<1THEN1730
1725 IF F(X)<1 THEN 1300
1730 P1=0\NEXT X
1740 GOTO 205
1749 REM FOR NEW GAME
1750 PRINT "O.K. CHICKEN.....YOUR NEW GAME STARTS IN A FEW SECONDS"
1755 FOR L=1 TO 250\NEXT L
1760 GOTO10
1799 REM SURRENDER
1800 PRINT "YOU YELLOW BELLIED SAP SUCKER!!!!!!!"
1805 PRINT "THE INDIANS HAVE TAKEN OVER THE FORT"
1810 PRINT "AND YOU HAVE GIVEN THEM A CHANCE TO TAKE OVER THE WEST."
1815 PRINT\PRINT\PRINT\PRINT\PRINT "   P.S. YOU HAVE BEEN SCALPED"
1820 GOTO 2046
1849 REM COMMANDS
1850 PRINT "(1) ATTACK"\PRINT "(2) MOVE MEN/CANNONBALLS"
1860 PRINT "(3) STATUS REPORT"\PRINT "(4) SURRENDER"
1870 PRINT "(5) NEW GAME"\PRINT "(6) LIST OF COMMANDS"
1875 D=D+.3
1880 GOTO 205
2000 REM     INT=INTEGER      TAB=TABULATE      REM=REMARK
2046 END
```

Disclaimer: Creative Computing assumes NO responsibility for any computer subjected to the following maintenance hints.



A Simplified Guide To Hardware Maintenance

David H. Ahl

Have you ever been annoyed that that new tape from Creative Computing software won't load properly every time. Chances are very good that more precise head alignment could cure the problem.

Or how about that key on the keyboard that sometimes sticks down. Maybe one day your kids had a peanut butter and jelly sandwich too near the keyboard and the key got sticky — but how do you clean it?

This short guide will give you some clues for solving these and other common maintenance problems. Expensive instruments are generally not needed, only time and a zest for experimentation. Before starting, clear a LARGE work area, the basement floor perhaps.

Cassette Head Alignment

First you'll have to disassemble the recorder. Most have four or more Phillips head screws accessible from the bottom. Most control knobs are friction fits and can be pulled off. The inevitable stubborn one can usually be removed by placing a chisel at the base and giving it a sharp blow with a hammer. Don't worry if the knob cracks — that's what crazy glue was made for.

To remove the head assembly may require jeweler's screwdrivers smaller than found in most home tool kits. Don't fret — a heavy-barreled screwdriver will effectively snap the head assembly out of its mounting. Simply employ it as a pry bar, placing the blade against the drive capstan for leverage.

Examine the head carefully, and then tap it sharply against a metal surface to dislodge foreign material. Deposits of oxide build up quickly and can adversely affect frequency response. Gently move a rasp back and forth across the pole pieces to make certain any oxide is fully removed. Any file ridges left by this operation can be burnished with sandpaper or emery cloth — or a grinder if available.

Place a thin bed of non-hardening putty in the head assembly mounting and replace the head assembly. This allows for fine alignment after reassembly. Indeed the head can actually be moved whilst playing a tape to get precise alignment.

Since the recorder is apart this is as good a time as any to lubricate the motor and drive spindles. You'll notice very few signs of grease and oil on recorders manufactured in Japan, Hong Kong and the Far East because of a shortage of lubricants in that part of the world. Not so here. Household oil is okay for the volume and tone controls but for the motor and drive capstans a better choice would be Castrol HD with STP oil treatment mixed in. A full quart is clearly overkill; two 35mm film containers full is just about the right amount. But don't be afraid of using too much — moving parts are always hungry for lubrication.

Rubber that has dried out becomes brittle and lifeless (did you every try using a 10-year old rubber band). Lest this happen to your cassette recorder, work in some cup grease to all the rubber drive belts. They'll slip a bit at first, but they'll last a lifetime.

Reassemble the recorder. If the screws were misplaced as so frequently happens, simply use filament tape and crazy glue in liberal quantities. After all, performance is the name of the game, not appearance.

Keyboard

Problems with the keyboard are generally either in sticky keys or in the keyboard encoder IC.

Sticky keys are usually caused by, appropriately enough, sticky substances on the keys such as jelly, bubble gum, hair spray, pine sap, and the like. Unfortunately lubrication alone will not always cure the problem because the sticky stuff must be removed also. Step one is to disassemble the keyboard — generally there will be four or six phillips-head screws on the bottom of the

housing. Some are trickier than others but if you keep removing screws, eventually the keyboard will be free. Disconnect any cables and lay the keyboard on your work surface.

The keytops are friction fitted and a sharp pull with lineman's pliers, or vice grips if available, will remove the tops. Since dirt and gook are our enemies, first hose down the keyboard with a high pressure spray from your garden hose. Following that, place the keyboard in your kitchen dishwasher — the keytops can be placed in the silverware container — and run it through the super pot scrubber cycle.

Since certain gummy substances are resistant to soap and water you may still require the services of a wire brush, preferably in a drill motor. Brush the entire keyboard whilst pouring on copious amounts various grease - cutting solvents in turn. Turpentine, lacquer thinner, ammonia, and Grease Relief are recommended.

If you have occasionally gotten an S when you typed A or O when you typed P, the problem is in the decoder chip. Find the largest IC on the keyboard and slip your ¼" screwdriver under one end and pry it out. Notice that the IC is symmetrical. Because of this it is frequently installed backwards on the rush-rush factory assembly line. Simply turn the IC around 180° and reinsert into the socket. A sharp blow from a ball peen hammer will insure that the IC is firmly seated and making good contact on all its pins. (IC's that are not socketed are beyond the scope of this article. For the experimenter, one clue: a soldering gun will not unsolder an IC. By the time you get to the 14th pin, the first ones will have cooled. Hint: a Bernz-O-Matic propane torch, even the small one, will release any IC up to 32 pins.)

Before reassembling the keyboard use the remainder of the Castrol/STP mixture to lubricate all moving parts. Reassemble the keyboard. You'll find that the keytops are interchangeable so this is the time to put the keys in alphabetical order if you wish. Children often find the computer less mystifying if the keys are in a familiar order.

Resist the temptation to power up the system immediately. Rather, go have a couple of beers and check the warranties on the recorder and keyboard. You may need them. Next month: Maintenance of the CPU and CRT.

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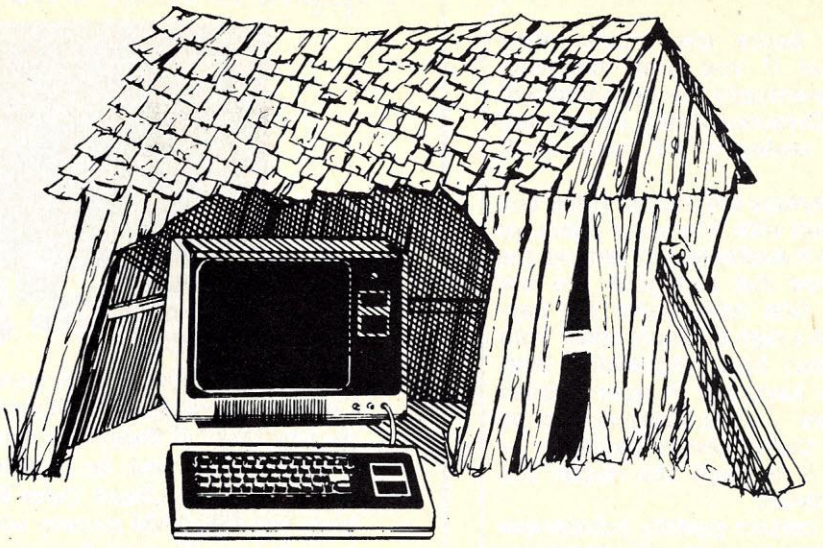
TRS-80 Strings

Stephen B. Gray



Now that we've reached the ninth column, it's time to get away from a steady diet of reviews, and give you something you can put right away on your TRS-80.

So with this issue, we begin a series on graphics, with an easy start that shows how to make overall random-number graphics designs.

Then we'll look at Radio Shack's own **Microcomputer Newsletter**, the toll-free 800 number for hardware and software help, the Tandy 10 and Tandy 150 computers, the Purser software list, and, coming full circle, a short op-art graphics program sent in by a reader.

An Easy Start in Graphics

Late last year, one of the many TRS-80 newsletters gave a short program as a filler at the bottom of a page:

```
10 CLS
20 X = RND(127)
30 Y = RND(47)
40 SET(X,Y)
50 GOTO 20
```

and said only that it produces a random graphics pattern.

Well, it creates a random scattering of graphics blocks that gradually fill the screen until the entire graphics display area is painted white. This is about as interesting as watching a barn door being painted. The pattern is much too large and haphazard to be pleasing.

The editor of that newsletter is one of many who are content to merely print material sent in by readers, with little or no comment or expansion. A great deal could have been said about this short and altogether boring program, by using it as the springboard to some really interesting random graphics patterns.

The first thing to do is to make the basic pattern smaller; the second is to make that pattern change continually rather than just fill the area.

This next program makes a smaller pattern:

```
10 CLS
20 X = RND(14)
30 Y = RND(6)
40 SET(X,Y)
50 GOTO 20
```

The pattern created is small enough for the eye to take in as a meaningful form. The program also eventually fills up the space, so the thing to do now is, every time a graphics block is turned on, just turn off a block somewhere else in the pattern. You can turn off the block just to the southeast of the block that just turned on, by adding a one to the X and Y coordinates in a RESET statement:

```
42 RESET(X+1,Y+1)
```

and placing it in the previous program.

If this is left to run long enough, you'll find that the top row and the leftmost column of the pattern eventually fill in and don't change any more. That's because there's nothing to turn off the graphics blocks in those areas. You could eliminate that static portion of the design by adding another line that turns off the block just to the northwest of the block originally turned on:

```
44 RESET(X-1, Y-1)
```

which results in a sparser pattern, with more black space in it. This is because for every graphics block you turn on, you're turning off two. In theory, that is, because sometimes you're trying to turn on a block that's already on, or to turn off one that's already off.

The pattern can be made even more sparse, if desired, by adding a RESET statement that turns off the block just to the northeast of the one turned on, with:

```
46 RESET(X + 1, Y-1)
```

and even more by turning off the southwest block with:

```
48 RESET(X-1, Y + 1)
```

which still creates enough of a pattern to be useful.

To see just how much sparser each of the added RESET lines makes the pattern, you can easily set up four patterns in a horizontal group, by adding SET lines that increase the X value by enough to offset the patterns to the right, and adding increasingly more RESET lines so that the first pattern has one RESET, and the last has all four RESET lines. If you can write this program, you'll have a better understanding of how to turn on and off exactly the points desired.

Any time you want to see exactly what's happening at SET or RESET time, you can slow down the action by putting a time-delay loop after each SET or RESET:

```
FOR Z = 1 TO 200
NEXT Z
```

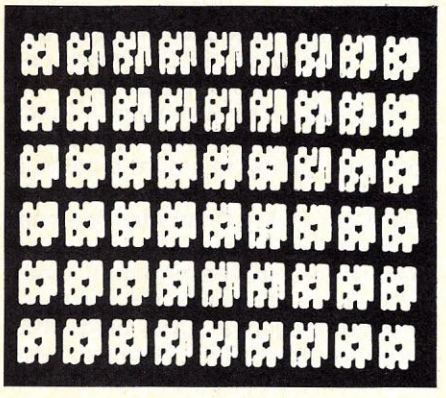
and you'll have plenty of time to observe what turns on or off, and exactly where.

Repeat Pattern

Now that we can create a constantly-changing pattern, let's repeat it across and down the screen in an allover style similar to wallpaper and fabric designs:

```
100 CLS
110 X = RND(10)
120 Y = RND(5)
130 FOR H = 0 TO 104 STEP 13
140 FOR V = 0 TO 35 STEP 7
150 SET(X + H, Y + V)
160 RESET(X + H + 1, Y + V + 1)
170 NEXT V
180 NEXT H
190 GOTO 110
```

This creates a matrix of identical patterns, each 10 x 5, with nine patterns across and six down. All 45 patterns are identical because the



program creates only one pattern, in lines 110 and 120, and then repeats it in H and V positions.

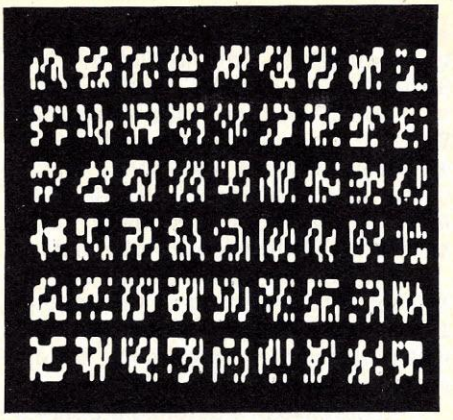
This all over design can be made much more interesting to look at by

removing the spacing between the patterns. Change lines 130 and 140 to:

```
130 FOR H = 0 TO 100 STEP 10
140 FOR V = 0 TO 30 STEP 5
```

which will create some fascinating overall designs that some people like to watch at great length.

As an example of what a big change can be made just by moving program lines around a little, first change lines 130 and 140 back to the way they were before, and then interchange lines 110 and 120 with lines 130 and 140. This makes all 54 patterns different, because the program first selects a position for the pattern with lines 110 and 120, creates a random pattern at that position with lines 130 through 160, and then goes on to the next position to create a



different pattern there. Because these patterns are all different, they need to be separated. Otherwise, the overall effect would be one big messy, totally random pattern again.

General Allover Program

A general program for creating allover designs is easily written:

```
100 CLS
110 PRINT "SIZE OF PATTERN
    (X,Y)?"
120 INPUT A,B
130 PRINT "HOW MANY
    PATTERNS ACROSS?"
140 INPUT C
150 PRINT "HOW MANY
    PATTERNS DOWN?"
160 INPUT D
170 CLS
180 X = RND(A)
190 Y = RND(B)
200 FOR E = 0 TO A*(C-1) STEP A
210 FOR F = 0 TO B*(D-1) STEP B
220 SET(X + E,Y + F)
230 RESET(X + E + 1,Y + F + 1)
240 NEXT F
250 NEXT E
260 GOTO 180
```

In lines 200 and 210, C-1 and D-1 are used to create the exact number of pattern across and down, because if C and D were used instead, there would be one extra column and one extra row. This is because E and F start with 0 instead of A. The same general effect could be created by changing line 200 to:

```
200 FOR E = A TO A*C STEP A
```

but then the overall design would be indented by the amount A, rather than beginning at 0, at the far left of the graphics area.

This general program could be further generalized by adding another variable, G, for a "how much space between patterns?" input.

This G would be added to the STEP at the ends of both lines 200 and 210, which means the patterns would be spaced apart both horizontally and vertically by the same number of graphics blocks.

To go even further, G could be used for the horizontal space between patterns, and H for the vertical space. And so on and on, until it really begins to get silly.

Other practical options could be added, such as a routine that would automatically center the allover design. If you really want to get fancy and perhaps unnecessarily helpful, another routine could be added to tell the user the maximum number of patterns, across and down, that will fit in the graphics area, depending upon the size of the pattern chosen.

Thus, if the user picks a pattern of size 7,7 the program would tell him that the maximum number of patterns that will fit in the graphics area is 18 across and 6 down. This way, the user doesn't have to do any figuring in his head (or with his calculator) to create the largest possible allover design. Although this added routine might be just a little too much icing on the cake, there are programs in which such calculations are a help to the user. One of the draw-a-line types of TRS-80 programs lets you know just how far you can continue a line in whatever direction you've aimed it, before you hit the edge of the graphics display area.

Incidentally, an interesting variation in the basic pattern can be created with just one little added line, in the preceding program:

```
215 SET(X + E-1,Y + F-1)
```

This changes the basic design element from a single graphics block to a pair of blocks, with one just to the northwest of the other.

This pattern is denser, because the basic element is two blocks instead of one. Another variation is to make the basic element two blocks that are side by side, which is almost a square element.

That's enough random-number graphics for now. Next time, we'll take a look at kaleidoscope graphics, or maybe Mondrian-stripe graphics. Or maybe even graphics-character graphics.

Microcomputer Newsletter

Radio Shack has been publishing, for owners of the TRS-80, a Microcomputer Newsletter, which hopefully most (if not all) of you have received by now.

The 8-page May issue provides, for example, information about the Hotline, a sale on the Screen Printer ($399 instead of the regular $599), what to do about kkkkeybounce,

Strings, con't...

improvements and corrections to several programs, new products, several short and useful programs, what to do about static electricity, etc.

The newsletter notes that the Telephone Interface has been discontinued, recommends that "no diskette be in the disk drive when the power is turned off," and gives an 800 number to call if you have any question about an existing service contract. Interesting, since, as I understand it, there were no service contracts in existence until the middle of May anyway.

A service contract, by the way, costs 15 percent of the current list price of the system, covers parts and labor for 12 months, and thus extends the original 90-day warranty to cover 15 months altogether. But the contract does not cover peripherals not made by Radio Shack, nor non-Radio-Shack RAM memory, nor any Radio Shack item you've modified.

Hotline 800 Service Number

For help with routine problems with your TRS-80, a toll-free WATS-line number is now available. Call 800-433-1679, or 1680. Radio Shack now has 17 people in the Computer Services Group to help you with hardware and software questions, which come in at the rate of 14,000 calls each month from customers, and another 6,000 from store personnel.

Radio Shack asks that you do not call for help in writing or debugging applications programs. As the new newsletter puts it, "We are not set up for customer software work."

"In the case of a detailed problem, it may be easier and more convenient for you to write. But always include a telephone number where you can be reached during business hours, because we will reply by phone. Address all inquiries to:

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Tandy Computers

Did you know there's a computer bearing the name of Tandy, parent company of Radio Shack? The Tandy 10 was created so that Radio Shack could offer, in its planned network of 50 Computer Centers, a more substantial computer than the TRS-80 to the businessman.

The Tandy 10, which will be sold in all the centers (all 50 may be open by the time you read this) is a relabeled ADDS System 70, manufactured by Applied Digital Data Systems (ADDS) of Hauppauge, NY. The minimum Tandy 10 is $9,995, and includes an 8080-based system with built-in CRT and keyboard, 48K of user RAM, two 8-inch Shugart disk drives for a megabyte of storage, Microsoft BASIC, and a disk operating system, ADOS (Advanced DOS), based on Digital Research's CP/M DOS.

There was also at one time a Tandy 150, sold only in the Fort Worth Computer Center in a pilot project. It was assembled by Radio Shack in Fort Worth using Computer Automation's 16-bit Naked Mini-4 single-board computer. The minimum Tandy 150 was $21,995, with 32K words of RAM, 10-megabyte CDC hard disk, Hazeltine 1500 CRT terminal, and CA's multi-terminal BASIC. It was discontinued because, as a Radio Shack executive said, "It was beyond the range of product we wanted to

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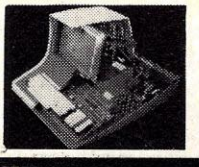

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support." Also, some 80 percent of the computers sold in the Fort Worth Computer Center have been TRS-80 machines.

The Tandy 10 will not be sold in the three unique Radio Shack "four-in-one" stores opened late last year in New York City, Chicago, and Washington, DC. The stores combine a Radio Shack, Computer Center, "Telephone Booth" for name-brand telephone products and accessories, and "Safe House" that features security products for home, family and business.

A Radio Shack executive told me, "From the way things are going here, within a couple of years from a half to a third of our business will be computers. A lot of our resources are devoted to computers, including design people and engineering people. We will have one hell of a full line of computers. We'll stay in audio, in hi-fi, and in parts, but computers are becoming more and more important here." Radio Shack's sales for Feb. 1979 were $66,565,000. This December they could well hit the $100 million mark.

Software Reference List

Robert Elliott Purser is a compulsive list-maker who previously published a list of all the S-100 boards he could find mention of. Now he's publishing, on a regular basis, a "Reference List of TRS-80, PET, & Apple II Computer Cassettes." This list is indispensible to any serious cassette-collector.

As the number of software cassettes grows, so does the Purser List. The first two editions were only a couple of pages each, and were mailed to anyone who sent in a SASE.

Edition 3, dated August 1978, and priced at $1, was 10 pages long. The $2 Edition 4, November 1978, was 24 pages long. The $4 Edition 5, February 1979, is 62 pages long, and consists of six pages of PET listings, a little over eight pages of TRS-80 program listings, about three pages of Apple II programs, 24 pages of reviews and screen photographs of various programs, and 17 pages of ads.

The fourth cover contains a highly interesting comment by Purser: "Well-meaning, instant programmers are selling amateurish, awkward, or awful programs. In time most of the programs on the market today will be rewritten, improved, and polished. But for now, 95% of all the programs listed in this magazine should never have been offered for sale. Be careful! Be selective! Your computer is only as good as the program you buy for it."

The **Reference List of Computer Cassettes** is published quarterly on the 15th of February, May, August, and November. The subscription rate is $12 a year in North America, from: Robert Elliott Purser, P.O. Box 466, El Dorado, CA 95623.

Incidentally, Purser recommends that "All TRS-80 Level-II 16K owners should get **Android Nim** from 80-US Magazine, and Apparat's Level-I **ROM in RAM** program."

Op-Art Graphics

"I have a nice small program for Level-II users (or Level-I with small modifications) to wash away the blues," writes Mark Richard Cusumano of King of Prussia, PA. He wrote it in one long line and one short

SMALL SOFTWARE SYSTEM TRS-80 PRODUCTS SMALL SOFTWARE SYSTEM

ADVENTURE 1 - ADVENTURELAND - $14.95 each or
ADVENTURE 2 - PIRATE'S ADVENTURE - all three for
ADVENTURE 3 - MISSION IMPOSSIBLE - only $39.95.

Machine language versions of Adventure, the current rage of the big time-sharing computers! 100+ word vocabulary! 30 rooms and locations. A challenge that can take weeks to solve! LEVEL-II 16K.

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RSM-2D: THREE MONITORS FOR TRS-80 DISK SYSTEMS - 29.95

22 commands to control your TRS-80 Z-80 processor! Examine ROM's, test RAM, program in machine language, read/write machine language tapes, and much more! A SYMBOLIC DUMP command disassembles memory into Z-80 mnemonics! Display memory in HEX or two ASCII formats, or EDIT, MOVE, EXCHANGE, VERIFY, FILL, ZERO, TEST, or SEARCH your memory! RSM-2/2D include all above features, plus read/write SYSTEM tapes, enter BREAKPOINTS, PRINT with our TRS232 or the expansion interface, and read/write disk sectors directly! RSM-2 loads at the top of 16K LEVEL I or II. RSM-2D, furnished on disk, has 3 versions for 16K, 32K and 48K.

BASIC-1P - LEVEL-1 BASIC WITH PRINTING! - $19.95

Run any LEVEL-1 BASIC tape (12K or less) in 16K LEVEL-II TRS-80 without conversion! Plus LLIST and LPRINT for TRS232, RS-232-C or Centronics printers. LPRINT ON and LPRINT OFF prints anything that you see on the screen! All LEVEL-I abbreviations and functions supported.

BARRICADE: MACHINE LANGUAGE ACTION GAME FOR TRS-80'S - $14.95

Break through 5-wall Barricade with high-speed ball and keyboard controlled paddle! Trap the ball among the walls and watch it destroy the 100 blocks! Select 96 different options to challenge experts and beginners. 3 scores with the best of each saved to be challenged by other players. NOBODY can achieve the maximum WEIGHTED SCORE of 33,000! 4K LEVEL-I and II.

AIR RAID: MACHINE LANGUAGE TRS-80 SHOOTING GALLERY! - $14.95

Shoot down high speed aircraft with a ground based missile launcher! Aircraft explode dramatically when hit, sometimes destroying other nearby planes! Score is tallied for each hit or miss, and the highest score is saved to be challenged by other players. Hours of fun for you, and a super demonstration program for entertaining friends! 4K LEVEL I and II.

TRS232 PRINTER INTERFACE - $49.95 (+$2.00 shipping)

Assembled and tested output port for TRS-80 printing. Use any RS-232 or 20-mil current loop ASCII printer. Expansion interface not required. Use with LEVEL-II BASIC, CP/M, BASIC-1P, ELECTRIC PENCIL, RSM-2/2D or your own programs! Standard cassette software included, or order new "FORMATTER" for $9.95 with TRS232 (see below).

TRS232 "FORMATTER" SOFTWARE PACKAGE - $14.95

Page and line length control, form feed function, printer pause, 9 baud rates, "smart" line termination, built-in keyboard debounce, software control of screen printing, etc. $9.95 if ordered with TRS232.

THE ELECTRIC PENCIL FOR TRS-80 DISK SYSTEMS - $150.00
THE ELECTRIC PENCIL FOR TRS-80 TAPE SYSTEMS - 99.95

Write text, delete, insert, or move words, lines or paragraphs, save text on tape (or disk), then print formatted copy with our TRS232 or Centronics printer (RS-232-C with disk version). Right justification, page titling and numbering, transparent cursor and repeating keyboard. Lowercase entry and display with minor modification. LEVEL-I or II 16K (Tape version).

CP/M OPERATING SYSTEM WITH TRS232 SOFTWARE - $145.00

SMALL SYSTEM SOFTWARE/LIFEBOAT ASSOCIATES version of CP/M. Includes TRS232 and RS-232-C software, lower-case support, debounce, plus DCV-2 and other unique utilities. CP/M Editor creates and modifies all files. Files may be much longer than your memory! Assemble directly from disk, placing HEX and PRINT files back onto disk! Includes DDT (Dynamic Debugging Tool), PIP (Peripheral Interchange Program), and more! 16K single disk required, 32K dual disk recommended.

DCV-1: CONVERT SYSTEM PROGRAMS TO DISK FILES - $9.95

Execute Adventure, Barricade, Air Raid, RSL-1, ESP-1, T-BUG, etc., from disk, even if they interfere with TRSDOS! After using DCV-1, your program loads from disk into high memory, moves itself to its correct address, then jumps there and executes!

OTHER TRS-80 PRODUCTS

ESP-1: $29.95 Editor, assembler, and monitor using INTEL 8080 mnemonics.
RSL-1: 14.95 Draw patterns, then play Conway's LIFE in machine language.
LST-1: 8.00 A disassembled listing of LEVEL-1 BASIC with some comments.

* CALIFORNIA RESIDENTS ADD 6 PER CENT SALES TAX *
* SMALL SYSTEM SOFTWARE * P.O. BOX 366 * NEWBURY PARK, CALIF. 91320 *

* SMALL SYSTEM SOFTWARE * P.O. BOX 366 * NEWBURY PARK, CALIF. 91320 *

CIRCLE 178 ON READER SERVICE CARD

Strings, con't...

line; here it's rearranged to be easier to figure out:

```
100 CLS
110 FOR A = 1 TO RND(100)
120 B = RND(128)-1
130 C = B + RND(127-B)
140 D = RND(48)-1
150 FOR E = B TO C
160 SET(E,D)
170 NEXT E,A
180 FOR A = 1 TO RND (100)
190 B = RND(48)-1
200 C = B + RND(47-B)
210 D = RND(128)-1
220 FOR E = B TO C
230 SET(D,E)
240 NEXT E,A
250 IF INKEY$ = ""THEN 250
    ELSE 100
```

This graphics program draws a random number of horizontal lines, then a random number of vertical lines, both groups with random beginnings and ends of lines. The result looks very much like some types of op art. When the "op art" is finished, you can start another drawing by pressing any key; line 250 takes care of this. □

STARFLEET ORION

A specially designed SF TACTICAL BATTLE GAME for your PET, TRS-80 or APPLE Computer.

The man called Sudden Smith watched the five blips on his screen spread out to meet the enemy. Two freighters converted into something like battlewagons, powerful but slow, and three real cruisers: the most powerful group of warships ever seen near the Promethean system — except for the Stellar Union fleet opposing them. Everyone was calling it Starfleet Orion, though it existed for only this day. It was life or death, and, after the object lesson on the planet Spring, everyone knew it.

STARFLEET ORION is a complete 2 player game system

- rule book
- battle manual
- cassette
- ship control sheets
- program listings

Includes 2 programs, 22 space ship types, and 12 playtested scenarios. Game mechanics are extremely simple, but play is exciting, challenging, and rich in detail. **Specify PET (8K), TRS-80 (Level II, 16K), or APPLE II (16K & 32K) $19.95.**

Ask your local dealer or send your check to:

Automated Simulations
Department C
P.O. Box 4232
Mountain View, CA. 94040

California residents please add 6% sales tax

CIRCLE 108 ON READER SERVICE CARD

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- **IRIDIS** is a monthly cassette magazine of programs for the **ATARI 400** and **800** personal computer.
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CIRCLE 190 ON READER SERVICE CARD

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>>>FASTGAMMON>>>

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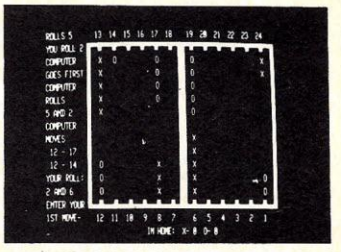

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- **TRS-80 (level II)**
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- **POLY-88**
- **COMPAL-80**

All versions require at least 16K. Apple disk requires 24K. Sol disk North Star only. Compal disk Micropolis dual density only. Poly-88 not available on disk.

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CIRCLE 175 ON READER SERVICE CARD

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Mr. Comp Uter
01010 Computer Lane
Tommorrow, U.S.A.
Dear Mr. Uter
No need to settle for second best any longer. Now you can produce "hard-copy" print-outs on a Selectric II, and do it
Mr. Comp Uter
01010 Computer Lane
Tommorrow, U.S.A.
Dear Mr. Uter:
No need to settle for second best any longer. Now you can produce "hard-copy" print-outs on a Selectric II, and do it at a low cost!
You really should get more information on SELECTRA-

IF YOU OWN A TRS 80*.....

TRS-80 is a product of Radio Shack, A Tandy Corporation

SELECTRA-PRINT PUTS YOU JUST A CABLE LENGTH AWAY FROM A "HARD—COPY" (Typewriter Quality: clean, clear, high-fidelity) Word Processing System!

. . .just a simple hook-up with the supplied cables and your *SELECTRA-PRINT* is ready to run.

For Word Processing on a TRS-80, for example, just command "LPRINT" and *SELECTRA-PRINT* automatically outputs clear, clean, high-fidelity, hard copy. . . . and of course you can use it to print-out any other information you might need.

SPECIAL NOTE:
***SELECTRA-PRINT* is a Selectric II typewriter and although it has been modified for computer print-out, it may still be used as a standard office typewriter.**

PRICE: $1,850.00* *TRS-80 Version $1925.00

OPTIONS:

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* ***SELECTRA-PRINT is VERSATILE!***
SELECTRA-PRINT is compatible with most micro- and mini-computers including ***PET ● Apple ● Heath H8 ● IMSAI ● Cromemco ● Alpha Microsystems ● Space Byte ● North Star Horizon ● SWTP ● Vector Graphic ● Sol ● Polymorphic ● Digital Group ● Ohio Scientific ● Altair ● Sorcerer Xitan ● Rex ● KIM ● EXORcisor . . . .***

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CIRCLE 154 ON READER SERVICE CARD

puzzles & problems

Merlin dropped by the office the other day, with a bundle of puzzles for this issue, and mentioned how pleased he was with the response he has been getting from our readers in the way of comments and new puzzles. If you have a favorite puzzle that you would like to share with the rest of the readership of Creative Computing please send it along. If Merlin uses it he will be pleased to send you a copy of "Merlin's Puzzler" volume 1 or 2.

In the April 1979 issue of Creative Computing we had a puzzle called "The Old Soup and Fish" where you were challenged to change the word "Soup" into the word "Fish" in eight moves. During each move the puzzler had to change one letter in the word so that a new word was formed. Mr. P.C. Hoell of Westtown, Pa., has come up with a solution which employes only 7 moves. Here it is; SOUP, SOAP, SLAP, FLAP, (or SLAT), FLAT, FIAT, FIST, FISH. A copy of "Merlin's Puzzler 2" is on the way. Does anyone care to try for 6 moves?

THE SQUARE OF SAMARKAND

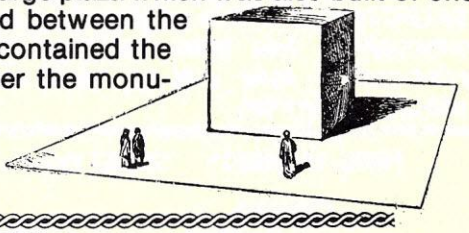
0	1	3	0	4
2	2	4	2	1
4	1	3	4	0
3	0	1	3	1
4	2	0	3	2

A thousand years ago a caravan from far off Samarkand came to Merlin's island with a puzzle to delight Merlin and his court. The puzzle consisted of 25 wooden blocks set in a frame. On the faces of the blocks were printed the numbers 0, 1, 2, 3, and 4, each number appearing on five of the blocks. To solve the puzzle you had to arrange the numbered blocks within the frame so that no number appeared twice in any row or column. Also, no number could appear twice across the two diagonals. Let us see how good you are at solving the Square of Samarkand.

PLATO'S CUBE

Our next puzzle is a very famous one attributed to Plato which would make it about 2411 years old. Whether there is any truth to this assertion is beyond the scope of this column. The problem is an interesting one which I think that you will enjoy.

There stood in Athens a large monument built of marble in the form of a cube. The cube was in turn constructed of many smaller cubes each one of which measured one foot on a side. Now, this great cube stood in the center of a large plaza which was also built of one foot marble cubes. The interesting relationship that existed between the monument and the plaza it stood upon was that they both contained the same number of cubes. (Note: the plaza continued on under the monument. Now, how many cubes were there in each?



THE BRAVE HUNTER

The next puzzle is from Mr. J. Franklin Campbell of Franklin, Massachusetts. "A man went hunting. After establishing his camp he traveled exactly 1 mile due south but found nothing. He then went exactly 1 mile due east and shot a bear. He then took the bear directly back to his camp, which was exactly 1 mile away. What color was the bear?"

A PROBLEM IN DEDUCTION

"Bless me, Holmes," exclaimed Dr. Watson, "It seems all so simple after you have explained it. I didn't have the foggiest as to who or what could have made those confounded tracks in the snow."

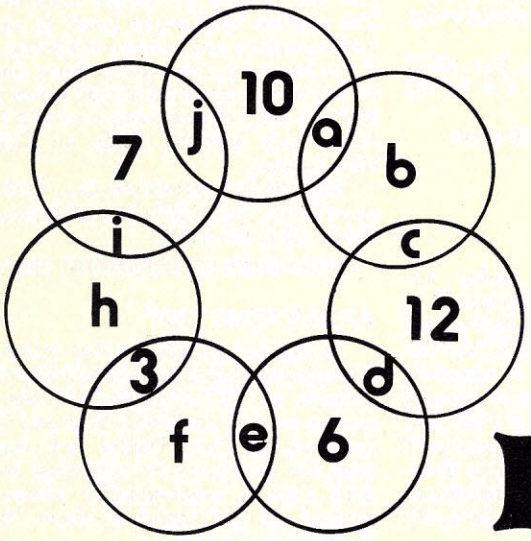
Holmes and Dr. Watson were taking a constitutional one evening after dinner when they chanced upon some very strange tracks in the snow. Holmes, of course, had known immediately what had caused the tracks and had challenged Watson to use his powers of deductive reasoning to arrive at a solution. Once again Watson failed. Can you do better?

A VALUABLE PROBLEM

In the May, 1979 issue of Creative Computing we presented a puzzle dealing with the North pole which challenged the reader to explain how eleven sleds could be placed on the ground in such a way that there would be seven rows of sleds, with each row containing four sleds. One of our readers, Mr. James C. Cave or Irving, Texas, didn't care very much for my "trick" solution (which made use of a twelfth sled left over from the previous puzzle). Like a good puzzler Mr. Cave came up with an excellent solution to the puzzle which I am happy to pass along. The reader should try solving this problem by using 11 coins instead of sleds. As stated before, you are to lay them out in such a manner that you will have seven rows of coins, and, that each row will contain four coins. Some of the coins will, of course, be in more than one row.

A copy of "Merlin's Puzzler 2" is Mr. Cave's reward.

THE CIRCLE PUZZLE

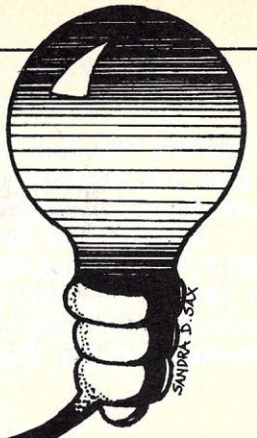


You'll be seeing circles before your eyes before you're finished with this puzzle. To the left is a figure composed of 7 interlocking circles. There are 14 enclosed areas in the drawing. You are to replace the letters in the drawing with numbers so that all of the numbers from 1 to 14 will appear in the drawing. The puzzle is to do this in such a manner that the numbers within any one circle will total 21.

I hope that you have enjoyed Merlin's selection of puzzles. We will be back again next month with a fresh batch to keep you on your toes.

Your editor,
Charles Barry Townsend

Compleat Computer Catalogue



We welcome entries from readers for the "Compleat Computer Catalogue" on any item related, even distantly, to computers. Please include the name of the item, a brief evaluative description, price, and complete source data. If it is an item you obtained over one year ago, please check with the source to make sure it is still available at the quoted price.

Send contributions to "The Compleat Computer Catalogue," *Creative Computing*, P.O. Box 789-M, Morristown, NJ 07960.

SOFTWARE

SOFT-ONE PROGRAMS

APPLE II Software Library Vol. I and II is a set of computer programs consisting of an assortment of games, teaching programs, and utilities. The programs vary in complexity from simple functions to involved simulations and include a variety of high and low resolution color graphics, sound effects, and user interaction via keyboard and control paddles. The programs are all written in integer basic. $14.95.

Soft-One, 315 Dominion Dr., Newport News, VA 23602.

CIRLCE 260 ON READER SERVICE CARD

APPLE SOFTWARE

Apple Computer, Inc. released volumes 3 through 5 of the Apple Software Bank, a library of user-contributed programs. The new programs include: FILE CABINET, a personal directory and record-keeping system; CHARACTER GENERATOR, a program to label high-resolution graphic images; CALIFORNIA DRIVER'S TEST, a simulation of the actual exam; INTEGER BASIC RENUMBER/APPEND; and 25 others.

Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014, (408) 996-1010.

CIRCLE 261 ON READER SERVICE CARD

AUTOCHECKERS

Lon Rater Software has developed Autocheckers for the Apple IIcomputer. Because Autocheckers contains numerous 6502 machine language subroutines it can play a challenging and enjoyable game of checkers. Any of seven levels of difficulty may be selected. Requiring 16K bytes Autocheckers employs the Apple high resolution graphics to provide colored pieces and numbered squares. $19.95.

Lon Rater Software, P.O. Box 57007, Webster, TX 77598.

CIRCLE 262 ON READER SERVICE CARD

FORTH LANGUAGE

```
TRS-80  "FORTH"  VER 1.1  SER#00010
  (C) 1978 PROGRAMMA CONSULTANTS
    ### ALL RIGHTS RESERVED ###
READY
DEC    ( SWITCH TO DECIMAL MODE )
7 3 + .   10
( DEFINE NEW WORD "TEST" TO COUNT 1 TO 30 )
: TEST 31 1 DO I . LOOP ;
OK TEST
   1  2  3  4  5  6  7  8  9  10  11  12  1
3  14  15  16  17  18  19  20  21  22  23  24  25
26  27  28  29  30
( OK DOES A CARRIAGE RETURN )
```

FORTH is a programmer's language that has been adapted by Programma International, Inc. for use with several microcomputer systems. Available are versions for Apple II, PET, Southwest Technical Products, Sphere, and TRS-80. FORTH requires only 6K. It can be placed in ROM if desired. This FORTH version runs from four to fifteen times faster than BASIC. Software development times are up to half of those needed for other languages. $35. on diskette for the Apple II, $50.

Programma International, Inc., 3400 Wilshire Blvd., Los Angeles, CA 90010, (213) 384-0579.

CIRCLE 263 ON READER SERVICE CARD

APPLE II LANGUAGE CAPABILITY

Apple Computer, Inc., today announced "The Language System," a plug-in option for the Apple II that allows users to develop software in PASCAL. The Language System comes as a complete package which includes a plug-in memory card, five diskettes containing PASCAL, as well as Integer BASIC and Applesoft Extended BASIC, and six manuals documenting the three languages. A minimum 48K disk-based Apple II is required to use the Language Card. $495.

Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014, (408) 996-1010.

CIRCLE 264 ON READER SERVICE CARD

FINANCIAL MANAGEMENT SYSTEM

The FMS was designed for the Apple II computer. The FMS is comprised of over 30 programs. The 30 programs were divided up into five separate modules. The five modules are: INVENTORY, ACCOUNTS PAYABLES, ACCOUNTS RECEIVABLES, GENERAL LEDGER and PAYROLL. All the programs are interconnected through Menus so that the user does not have to run programs. Menus allow the user to select programs or processes simply by entering a number that corresponds to the English description of the program or process. $10.00

Darrell's Appleware House, 17638 157th Ave., Renton, WA 98055.

CIRCLE 265 ON READER SERVICE CARD

DATABASE FOR APPLE II

DATABASIC is a database management system that fits in a 16K Apple II with Disk II. It can create and maintain files, and access information from them. There is no limit on the number of fields you can specify to access information. The system configures itself to use as much memory as you have available; also, if you have a printer the system can use it. Records may be up to 250 bytes long, and you may define from 0 to 100 fields which may overlap. $100, on diskette with manual.

Holistic Data Systems, Inc., 2210 Wilshire Blvd., Suite 446, Santa Monica, CA 90403, (213) 450-6192.

CIRCLE 266 ON READER SERVICE CARD

APPLE 'WHATSIT'

Computer Headware has introduced an Apple model of its self-indexing query system, call WHATSIT?. Like the companion models for North Star and CP/M systems, the new Model A-1 answers typed-in questions by referring to disc data that it automatically stores and revises, as instructed in short "pidgin English" sentences.

Computer Headware, P.O. Box 14694, San Francisco, CA 94114.

CIRCLE 267 ON READER SERVICE CARD

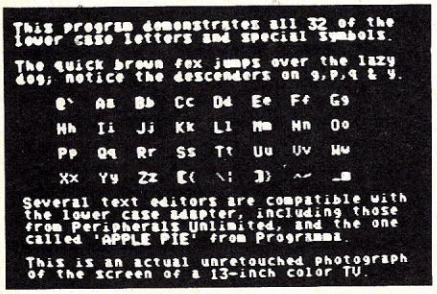
DISK OPERATING SYSTEM

Apple Computer, Inc. has announced the "Disk Utility Pack," a collection of system software routines for disk-based Apple II computers. The new programs include: DOS 3.2, the latest version of the Apple II Disk Operating System; update which upgrades the existing DOS on any diskette to the 3.2 version without disturbing any other programs; applesoft chain, which allows one extended BASIC program to run a second without losing data defined by the first; renumber1 merge, which renumbers and combines several extended BASIC routines into a single program. $25.

Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014, (408) 996-1010.

CIRCLE 268 ON READER SERVICE CARD

APPLE LOWER CASE


This program demonstrates all 32 of the lower case letters and special symbols.
The quick brown fox jumps over the lazy dog; notice the descenders on g,p,q & y.
Several text editors are compatible with the lower case adapter, including those from Peripherals Unlimited, and the one called 'APPLE PIE' from Programma.
This is an actual untretouched photograph of the screen of a 13-inch color TV.

The Lower Case Adapter (LCA) features: plugs in with no modifications to the Apple; displays lower case letters with descenders, includes necessary symbols; fully compatible with Apple's Disk-II* DOS; compatible with most printers that have lower case; and, one full year repair or replace warranty. $49.95.

Dan Paymar, P.O. Box A-133, C.S. 6800, Costa Mesa, CA 92627, (714) 645-1411.

CIRCLE 269 ON READER SERVICE CARD

APPLE-80

Dann McCreary has announced APPLE-80, an 8080 simulator and debug package designed for the APPLE II 6502-based computer. Any 16K or larger APPLE II can run programs written for the 8080 and can be used as a design and debugging aid for the development of original 8080 software. APPLE-80 provides single-step, trace and run modes and executes all valid 8080 op-codes. Illegal op-codes are rejected. All 8080 registers are visible on the APPLE screen and may be modified at will. 8080 I/O port addresses are arranged in a table for ease of user modification. Up to 8 breakpoints may be set to facilitate program debugging. 6502 subroutines may be called directly from 8080 programs, allowing full access to APPLE monitor and user-written functions. Conversely, 8080 routines may be embedded in 6502 programs. Vectored interrupts are also simulated. $20.00 + $1.50 shipping.

Dann McCreary, Box 16435-C, San Diego, CA 92116.

CIRCLE 270 ON READER SERVICE CARD

APARTMENT MANAGEMENT

An apartment complex management program is available for TRS-80 and Micropolis Mod II systems. The package includes extensive documentation and a user's guide written for non-programmers. The system includes an initialization segment and forms used to organize and set up the data base. Functions include listing transactions, posting rents, listing vacated tenants, tabulation of all transactions, vacancy listing, delinquent tenant listing, mailing labels and more. $150.

Honest John's Software, 8929 Cardinal Terrace, Brentwood, MO 64144, (314) 961-1946, (314) 961-3726.

CIRCLE 271 ON READER SERVICE CARD

TRS-80 "SUPER DISKS"

National Software Marketing, Inc., has announced the release of "Super Disk" software packages that run on the radio shack TRS-80 computer system Super Disk - 1 contains 42 programs. Super Disk-1A for a single disk system contains eight less programs than super disk-1 designed for a dual floppy configuration. Programs included are inventory, amortization, bio rhythm, depreciation, decision theory, mailing list, payroll, space games, racing games, strategy games and graphics games. Super Disk-2 is for the mathematician or the business man. It contains 70 programs. It is designed for a dual floppy configuration, super disk-2 has interest calculations, investment analysis, geometric calculations, trig calculations, statistical analysis, depreciation, and conversions. $13.95.

National Software Marketing, 4701 Mc Kinley St., Hollywood, FL 33021.

CIRCLE 272 ON READER SERVICE CARD

U.S. ECONOMY SIMULATION

Applied Economic Analysis has released a quarterly macro-economic Simulation Model of the U.S. Economy for the TRS-80. The model has been developed for use by those whose business operations are effected by government policy actions. The user manual is extensive, explains how the model works and also offers guidelines for constructing "easy money" or "fiscally tight" economic policies. $179.

Applied Economic Analysis, 4005 Locust Ave., Long Beach, CA 90807, (213) 424-3652.

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CIRCLE 145 ON READER SERVICE CARD

MAILLIST

MAILLIST, a database system for mailing lists has been announced by Automated Resource Management Inc. The system is for the Radio Shack TRS-80 and provides the ability to ADD, DELETE, CHANGE, and INQUIRE records. Reports and mailing labels are generated. Optional secondary files automatically maintain ZIP and two DATE files so that reports and mailing labels may be sorted by Last Name, Zipcode, DATE 1, or DATE 2. Each record has 30 attributes used in selection of records for reports or labels. $34.95.

Automated Resource Management Inc., P.O. Box 4353, Irvine, CA 92716.

CIRCLE 274 ON READER SERVICE CARD

PET SOFTWARE

Minnesota Micro Systems, Inc. has announced two new software products for PET users. They are: Backgammon, $19.95; and Labyrinth, a game of skill, $12.95.

Minnesota Micro Systems, Inc., 514 Cedar Ave., Minneapolis, MN 55454.

CIRCLE 275 ON READER SERVICE CARD

TRS-80 FINANCE SOFTWARE

FIN-I is consisted of 2 programs: BANK-I (a check balancing system) and STOCK-I (a stock security information system) for the TRS-80 system. BANK-I lets the user save and restore the data base to and from a data cassette, it produces reports, and it allows the user to modify the data base.

Micro Architect, 96 Dothan St., Arlington, MA 02174.

CIRCLE 276 ON READER SERVICE CARD

KFS80

KFS80, an Indexed Sequential Access Method facility for use on the Radio Shack TRS-80 has been announced by Automated Resource Management Inc. It provides keyed and sequential access to multiple files, each with records of up to 240 bytes. The system is characterized by a relatively constant number of disk accesses to reach a record no matter how large the file grows. It is coded in BASIC and requires less than 8KB of memory. Minimum system configuration is a 2 drive 32KB system. $49.95.

Automated Resource Management Inc., P.O. Box 4353, Irvine, CA 92716.

CIRCLE 277 ON READER SERVICE CARD

BASIC DOS FOR TRS-80

Percom Data Company has introduced a disk operating system for Radio Shack's TRS-80 computer that works entirely with Level II BASIC commands. Called MICRODOS, the program resides in less than 7K of memory. It was developed for business and professional applications. MICRODOS is supplied on a system diskette that includes three BASIC programs: (1) a file management program, (2) a disk utility program, and (3) a sample application program. $29.95.

Percome Data Company, 211 N. Kirby, Garland, TX 75042, (214) 272-3421.

CIRCLE 278 ON READER SERVICE CARD

TRS-80 BUSINESS-AIDES

Occupational Computing Company, Inc. is offering an accounts receivable, billing and inventory control system for finished goods. $750; accounts receivable, billing and inventory control for manufacturing $1495; accounts payable $350; payroll $350; client accounting $1495; securities graphics $495; medical billing $1495; radiologist-aide $1995; trucking-aide $1995; and construction-aide $1995.

Occupational Computing Company, Inc., 22311 Ventura Blvd., Suite 123, Woodland Hills, CA 91364, (213) 999-1919.

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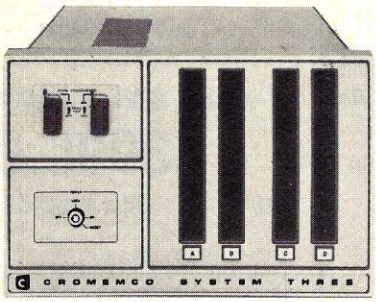

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CIRCLE 151 ON READER SERVICE CARD

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MICRO has been published regularly since October, 1977. Articles that appeared in the earlier issues of MICRO may be obtained in two bound anthologies, BEST OF MICRO Volume 1 and the companion collection ALL OF MICRO Volume 2, both available at computer stores or from the magazine.

CIRCLE 157 ON READER SERVICE CARD

PROGRAM DECODER

Southwest Micro-Systems has announced the latest in their line of software for the North Star HORIZON. The WIZARD program allows you to save North Star BASIC programs in text format so that you can use your favorite text editor to modify your programs. All tokens, line numbers and other abbreviations are expanded to their full ASCII format. $19.95.

Southwest Micro-Systems; P.O. Box 20088; Riverside, CA 92516.

CIRCLE 280 ON READER SERVICE CARD

GAMES FOR NORTH STAR

Three new game diskettes are available from JJR Data Research. Diskette #1 contains 3-D Tic-Tac-Toe and a chess game with 3 levels of play. Diskette #2, called Baseball, is a program for baseball enthusiasts who like to collect statistics on teams - and predict who is going to wind up in the World Series. Basketball, Diskette #3 is another statistic-gathering program. $25 each.

JJR Data Research, P.O. Box 74, Middle Village, NY 11379.

CIRCLE 281 ON READER SERVICE CARD

TEXT EDITOR/WORD PROCESSOR

Maryellen text editor/word processing system is available for the North Star disk that contains the features of the North Star BASIC editor, string handling features of large computer editors, and word procesing capability. There are 29 commands including AUTO, DELETE, RENUMBER, SCRATCH, LOAD, SAVE, NULL, EDIT, LIST, NSAVE, APPEND, and QUIT similar to those commands in North Star BASIC. String handling commands include FIND, CHANGE, CHANGE ALL, MOVE, and COPY. Word processing commands include OPEN, TITLE, LINE, SPACE, UNIT, PAGE, JUSTIFY, REPEAT, and PRINT. Line fill, justification to the right margin, centering of titles, automatic insert (for use in form letters), titles, page numbering, and forms control are done under the PRINT command. Multiple printers can be used. Different page sizes can be handled. Twenty-six messages give specific information on errors and system action. $38.

Surf Computer Services, P.O. Box 3218-B, North Hollywood, CA 91606.

CIRCLE 282 ON READER SERVICE CARD

DATABASE MANAGEMENT SYSTEM

Global Parameters has announced GLOBAL, a database management system. It is a management system for database creation and list maintenance. GLOBAL runs under CP/M and CBASIC2 on a microcomputer system in only 40K RAM. It can be used for diverse applications such as inventory systems, mail lists, indexing collections, history reports, payroll files, accounting files, price lists, and client lists. $35.

Global Parameters, 1505 Ocean Ave., Brooklyn, NY 11230, (212) 252-5002.

CIRCLE 283 ON READER SERVICE CARD

3 Diskless TRS-80 Programs

— telephone/address/mailing list program sorts by name or zip code. Retrieves telephone number from name and vice versa. Access time is under 2 seconds. Over 100 listings.
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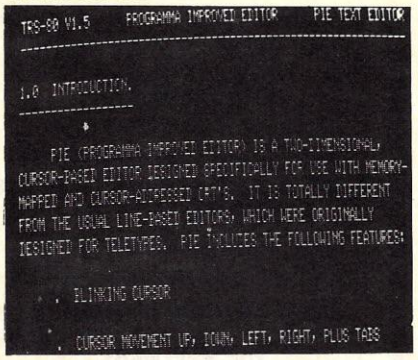
CIRCLE 171 ON READER SERVICE CARD

EDITOR FOR TRS-80 AND SPHERE


TRS-80 V1.5 PROGRAMMA IMPROVED EDITOR PIE TEXT EDITOR
1.0 INTRODUCTION.
PIE (PROGRAMMA IMPROVED EDITOR) IS A TWO-DIMENSIONAL, CURSOR-BASED EDITOR DESIGNED SPECIFICALLY FOR USE WITH MEMORY-MAPPED AND CURSOR-ADDRESSED CRT'S. IT IS TOTALLY DIFFERENT FROM THE USUAL LINE-BASED EDITORS, WHICH WERE ORIGINALLY DESIGNED FOR TELETYPES. PIE INCLUDES THE FOLLOWING FEATURES:
. BLINKING CURSOR
. CURSOR MOVEMENT UP, DOWN, LEFT, RIGHT, PLUS TABS

Programma International, Inc. has announced their text editor, called PIE, or Programma Improved Editor. The 2-dimensional, cursor-based editor is designed to operate on the TRS-80 Level II (16K) and Sphere 6800 systems. The program generates cassette tapes which are compatible with the TRS-80 Editor/Assembler. PIE is sold on cassette and diskette for the TRS-80 and Sphere, complete with operating instructions. The cassette version is priced at $19.95, and the diskette version for Apple at $24.95.

Programma International, Inc., 3400 Wilshire Blvd., Los Angeles, CA 90010, (213) 384-0579.

CIRCLE 284 ON READER SERVICE CARD

WORD PROCESSING SOFTWARE

Peachtree Software has announced Power Text, a word processing software system for microcomputers. Power Text is a document entry, editing and printing system designed for office users. It offers easy-to-use commands, global search and replace capability, automatic margin justification, automatic page numbering, both left and right indention, superscripting and subscripting, linking of long documents from diskette to diskette, floating spaces to allow for insertion of diagrams, the ability to handle either single sheet stationery or continuous forms, and complete self-instructing documentation. Power Text is written in a high level assembly language and executes within the CP/M Operating System or equivalent.

Peachtree Software, Retail Sciences, Inc., Suite 254, 3384 Peachtree Rd., N.E., Atlanta, Ga 30326, (404) 231-2303.

CIRCLE 285 ON READER SERVICE CARD

UCSD PASCAL SOFTWARE

Pickles & Trout has announced the availability of two software packages for the UCSD PASCAL operating system: FORMOUT is a collection of routines to do formatted output from PASCAL programs. $20. CPMREAD translates CP/M disk files to PASCAL text files, $25.

Pickles & Trout, P.O. Box 1206, Goleta, CA 93017, (805) 967-9563.

TI 99/4 SOFTWARE

TI's Solid State Software command modules include: Household Budget Management, Home Financial Decisions, Beginning Grammar, Early Learning Fun, Number Magic, Physical Fitness, Video Chess, Football, and Video Graphs.

Texas Instruments Incorporated, P.O. Box 53, Lubbock, TX 79408.

CIRCLE 286 ON READER SERVICE CARD

MICROPOLIS SOFTWARE

Basically Speaking has announced the availability of software for the Micropolis minidisk systems. The first three programs are STATPAK, GRADEBOOK/REPORTCARD, and PAL (Personal Accounts Ledger). $45.

Basically Speaking, software by Thom Hogan, 719 Anna Lee Lane, Bloomington, IN 47101.

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NESTAR SYSTEMS INCORPORATED

CIRCLE 165 ON READER SERVICE CARD

BOOK INVENTORY/DATABASE PROGRAM

A software package called BOOKS.BAS which runs on CP/M systems with CBASIC-2 has been released by Holliday Software. The purpose of the Book Inventory Program is to file and maintain an inventory of books on a disk. The program is flexible enough so that it can also be used to file and maintain databases containing other types of data. The program is written in CBASIC-2 and requires the CP/M operating system, a minimum of 24k of contiguous RAM (32k or more is recommended), $49.95.

Holliday Software, 4807 Arlene St., San Diego, CA 92117.

CIRCLE 288 ON READER SERVICE CARD

8080 BUSINESS SOFTWARE

California Microcomputer Company, Inc., has announced business software for use with 8080 or Z-80 based CP/M microcomputer systems. The package includes: 1) General Ledger with user-formatted Income Statement and Balance Sheets; 2) Accounts Receivable which is either open item or balance forward; 3) Accounts Payable includes mailing labels and check printer; 4) Payroll includes W-2 and check printing. $15, manual.

California Microcomputer Company, Inc., P.O. Box 3199, Chico, CA 95927.

CIRCLE 289 ON READER SERVICE CARD

EASZ80 MONITOR SOFTWARE PACKAGE

EASZ80 MONITOR is a 1K code resident monitor designed to provide an extremely flexible "software front panel" for Z80 microcomputer systems not having a front panel. It provides: ability to stop or start the "front panel" display just by striking any key except the return key, memory display, memory alter, memory search for string of bytes, memory movement, memory compare and input/output port query. It features: 1K memory size, ability to search or compare with a prescribed memory address area and ability to stop and start the display at will. $30-$70.

Electro Analytic Systems, Inc., P.O. Box 102, Ledgewood, NJ 07852, (201) 361-4300.

CIRCLE 290 ON READER SERVICE CARD

MULTIUSER BROCHURE

The PANA/BASIC multiuser operating system for microcomputers is summarized in a five-page brochure. the publication details special features and performance capabilities of the system. The system is available for a variety of microprocessors including Intel 8080, 8085, and Zilog Z80. Free.

Panatec Inc., 1527 Orangewood Ave., Orange, CA 92668, (714) 633-8961.

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ALPHASMITH WORD PROCESSOR

The ALPHASMITH is designed to run on a 32K North Star HORIZON system with a SOROC, HAZELTINE, or INTER-TUBE terminal. It uses the features of these terminals to provide a simulated memory-mapped editting environment. Justification is provided through variable spacing and necessitates the use of a DIABLO HyType II printer or equivalent. It provides full on-screen editing of your text, complete cursor control, block movement and deletion, and many other useful editing functions, automatic carriage returns, insertion of names, addresses and other data (up to nine fields) from a separate datafile, automatic page numbering, and four different automatic paragraph options. $299.

Southwest Micro-Systems, P.O. Box 20088, Riverside, CA 92516.

CIRCLE 292 ON READER SERVICE CARD

BASICALLY SPEAKING SOFTWARE

Basically Speaking has announced two new software offerings: for TRS-80 and Exidy users, Statpak and MoneyOne are now available on cassette for $11.95. Statpak has five programs - ANOVA, T-test, Linear Correlation, Analysis of Covariance, and Generalized Statistics. MoneyOne consists of four programs - Loans, Networth, Budget, and Checkbook. the second is for Micropolis and Micropolis CP/M users and consists of three business packages. First, a complete Accounts Receivable and Accounts Payablepackagefor$95. Also, Inventory, a customizable program which allows the user to specify what data are kept on inventory items, and Postman, a mailing list and label program which includes room for heretofore ignored fields such as job title, company name, foreign postal codes, remarks, and identification numbers. Inventory and Postman are $45 each, or $85 if ordered together.

Basically Speaking, 719 Anne Lee Lane, Bloomington, IN 47401.

CIRCLE 293 ON READER SERVICE CARD

BUSINESS SOFTWARE

With the addition of four new software programs, Accounts Receivable, Accounts Payable, General Ledger, and Job Costing, Graham-Dorian Software Systems offers business and industry a full line of computer software. The packages are compatible with Northstar, IMSAI, Altos, Cromemco, Industrial Micro Systems, Radio Shack TRS-80, SD Systems, Digital Microsystems, Dynabyte DB8/2, Micropolis MOD II, Vector MZ, and other 8080, 8085, and Z80-based systems.

Graham-Dorian Software Systems, 211 N. Broadway, Wichita, KS 67202, (316) 265-8633.

CIRCLE 294 ON READER SERVICE CARD

LEGAL TIME ACCOUNTING SOFTWARE

21st Century Software has announced the release of their Legal Time Accounting Software Package. This Software package, which runs on the PolyMorphic 8813 desk top microcomputer, will handle the legal timekeeping and billing for law offices having up to 12 attorneys. The software is command driven, and allows the clerk or secretary to enter client and case information which the computer organizes and stores for later retrieval. The package completely automates client timekeeping and billing, and can be modified to print desired reports. $800.

21st Century Software, 3201 Carew Tower, Cincinnati, OH 45202.

CIRCLE 295 ON READER SERVICE CARD

BOWLING LEAGUE SOFTWARE

A series of programs to maintain team, player, substitute, and accounting information of a bowling league is available. Appropriate standings and statistics reports are produced. The system features 'plain English' data entry prompting with extensive editing, making it easy to use by bowling league secretaries with no computer knowledge. Version A is customized for a single league and costs $35. Version B is intended for multi-league service bureaus and/or direct entry and use by the bowling establishment and league staff. $295. Available on 5" or 8" diskettes, written in NorthStar (TM) BASIC or CBASIC-2 (TM).

Dieter Kaetel, 7201 87th Ave. SE, Mercer Island, WA 98040, (206) 232-1513.

CIRCLE 296 ON READER SERVICE CARD

CP/M KEYED FILE SUPPORT

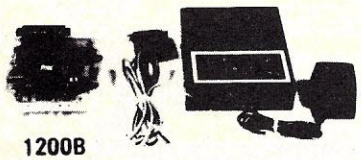
Micro Applications Group has introduced a keyed file management system called MAGSAM designed for the CP/M operating system. MAGSAM enables users of CP/M and CBASIC to create and access data records quickly and directly by user defined keys. Three versions of MAGSAM are available: MAGSAM III is the most advanced version and supports multiple keys, secondary indexing, and full delete capability, MAGSAM II is a single key implementation with full delete support, MAGSAM I is the entry level version and supports single key file structures with deletes performed by file reorganization. All versions of MAGSAM are available on standard 8'', Micropolis, and TRS-80 diskette formats in source form. A Single site license for MAGSAM III is $145, MAGSAM II is $99, and MAGSAM I is $75.

Micro Applications Group, 7300 Caldus Avenue, CA 91406.

CIRCLE 297 ON READER SERVICE CARD

PET PRINTER ADAPTER

GET HARD COPY FROM YOUR COMMODORE PET USING A STANDARD RS-232 PRINTER



1200B

1200C

The CmC ADA 1200 drives an RS-232 printer from the PET IEEE-488 bus. Now, the PET owner can obtain hard copy listings and can type letters, manuscripts, mailing labels, tables of data, pictures, invoices, graphs, checks, needlepoint patterns, etc., using an RS-232 standard printer or terminal.

$98.50 ADA 1200B
Assembled and tested

$169.00 ADA 1200C
With case, power supply and RS-232 connector

master charge VISA

Order direct or contact your local computer store. Add $3.00 for postage and handling per order.

CONNECTICUT microCOMPUTER
150 POCONO RD, BROOKFIELD, CT 06804
(203) 775-9659

CmC

CIRCLE 125 ON READER SERVICE CARD

ACCOUNTS/INVOICING SYSTEM

The Accounts Receivable/Invoicing System is written in Computerware's RANDOM BASIC and runs under SSB's Random DOS on an M6800 system. The system has the capability to invoice for goods or services. It is a menu driven, interactive, self-prompting, on-line system. It can also accept billing entries and print monthly statements. The invoicing function will provide a report of sales broken down by various tax categories. $20 for manual.

Computerware, 1512 Encinitas Blvd., Encinitas, CA 92024, (714) 436-3512.

CIRCLE 298 ON READER SERVICE CARD

INTERACTIVE COMPILER

Interactive Microware, Inc. has announced BASEX, a compact high-speed interactive compiler. BASEX is a new intermediate-level language for microcomputers that combines some of the best features of both BASIC and EXecutable machine language code. The BASEX compiler is fully interactive and allows you to enter, list, edit and run your program without the help of any auxiliary programs such as editors, or linkage editors. $8 manual; $25 Tape/diskette.

Interactive Microware, Inc., P.O. Box 771, State College, PA 16801.

CIRCLE 299 ON READER SERVICE CARD

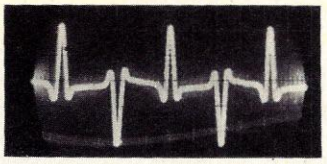
WORD PROCESSING SOFTWARE

Micropro International Corporation has announced a word processing software system called WORD-STAR. Available for 8080, 8085 and Z-80 microcomputers, WORD-STAR features on-screen text composition, right and left justified margins, page breaks, centering, and underlining, user set place markers, block move/copy/delete and file merging operations; variable tab stops and margin settings, and concurrent printing and editing.

MicroPro International Corporation, 1299 Fourth St., San Rafael, CA 94901, (415) 457-8990.

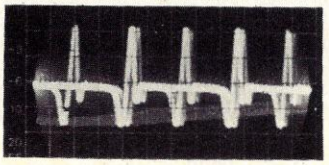
CIRCLE 300 ON READER SERVICE CARD

LEVEL II DUPLICATION



ABOVE: COOK EXTENDED FORMAT

BELOW: CONVENTIONAL FORMAT



Cook Laboratories has announced an extended format for duplication of TRS-80 Level II cassettes. Regular format source tapes are automatically converted into bi-polarity (bits one way, clocks another way).

Cook Laboratories, Inc., 375 Ely Avenue, Norwalk, CT 06854.

CIRCLE 225 ON READER SERVICE CARD

MULTITASKING EXECUTIVE FOR THE 8086

MTOS-86 is a real-time, multitasking operating system for microprocessors. Its facilities include memory management, an unlimited number of tasks, event flags, networking and support for multiprocessor configurations. Fast interrupt processing insures proper handling of time-critical functions. $950.

Industrial Programming, Inc., 9 Northern Boulevard, Greenvale, NY 11548.

CIRCLE 226 ON READER SERVICE CARD

SAM76

The Second Edition of the SAM76 language manual is now available. This is a revised and enlarged edition which incorporates new material published in magazines during 1978. Price is $15.00 postpaid (Fourth Class Mail - for first class mail add $2.00).

A limited quantity of 64 page inserts which may be used to upgrade the First Edition of the SAM76 languages manual are available and are priced at $5.00 each.

A SAM76 language implementation of the Adventure game, with the added features of being bilingual (French and English as well as optionally "PG" rated) is available on 8" single density disk suitable for use on 31K CP/M systems. Five inch disks are available in English and rated "A" only - (French version available on request). Price is $20.00 postpaid.

SAM76 Inc., Box 257, RR1, Pennington, NJ 08534.

CIRCLE 227 ON READER SERVICE CARD

M6800 BASIC

Computerware has announced BASIC on the M6800. It has 26 commands, 27 functions, 20 statements, and 22 disk commands along with 9 digit precision. This RANDOM-ACCESS BASIC has Logical I/O which provides hardware independence and allows passing parameters to and from assembly language subroutines. Some of the outstanding features are "PRINT USING," "ON ERROR," and "CALL." It allows the creation, easy manipulation, and even expansion of true RANDOM FILES. The random files can be accessed in a random manner or sequentially. There can be 10 sequential and 10 random files open concurrently. $99.

Computerware, 1512 Encinitas Blvd., Encinitas, CA 92024, (714) 436-3512.

CIRCLE 228 ON READER SERVICE CARD

AIRCRAFT SIMULATOR

Aircraft Instrument Simulator is a new computer program designed to create a real-time, high resolution, color graphics simulation, with engine sound effects, of an aircraft instrument panel which realistically responds to input from the keyboard and playing paddles. the aircraft instruments appear on the TV screen and respond smoothly and in real time to the keyboard and game paddles to control the simulated airplane. The instruments display includes attitude, airspeed, altitude, rate of climb and descent, compass heading, and rate of turn of the aircraft. $8.95.

Soft-One, 315 Dominion Dr., Newport News, VA 23602.

CIRCLE 229 ON READER SERVICE CARD

CMC

KIM ANALOG INPUT

Analog to Digital Conversion System for the KIM Computer

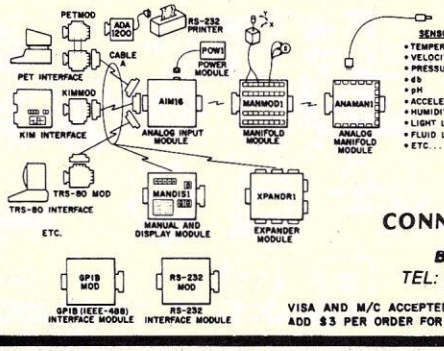
DAM SYSTEMS

Give the KIM the ability to sense, measure, and control the world around it with DAM SYSTEMS modules. Just plug the KIMSET1 into the KIM to get 16 channels of analog input. Screw terminals are provided for each channel so you can hook up joysticks, pots, or whatever appropriate sensors you have.

Each of the 16 analog inputs, in the range of 0 to 5.12 volts, is converted to a decimal number between 0 and 255 (20 millivolts per count). Conversion time is 100 microseconds.

The KIMMOD provides one user port as well as a DAM SYSTEMS port.

Software is provided.



KIMSET 1

1 - AIM161	- 16 ANALOG INPUTS - 8 BITS - 100 MICROSEC
1 - KIMMOD	- KIM ADAPTER - 1 USER PORT - 1 DAM SYSTEMS PORT
1 - CABLE A24	- 24 INCH INTERCONNECT CABLE
1 - MANMOD1	- MANIFOLD MODULE - SCREW TERMINALS FOR INPUTS, REFERENCE, GROUND
1 - POW1	- POWER MODULE

KIMSET1a for 110 VAC $ 285
KIMSET1e for 230 VAC $ 295

Order direct or contact your local computer store.

CONNECTICUT microCOMPUTER, Inc.
150 POCONO ROAD
BROOKFIELD, CONNECTICUT 06804
TEL: (203) 775-9659 TWX: 710-456-0052

VISA AND M/C ACCEPTED - SEND ACCOUNT NUMBER, EXPIRATION DATE AND SIGN ORDER.
ADD $3 PER ORDER FOR SHIPPING & HANDLING - FOREIGN ORDERS ADD 10% FOR AIR POSTAGE

CIRCLE 125 ON READER SERVICE CARD

COMPUTERS

TI HOME COMPUTER

Designated the TI-99/4, the TI home computer uses Solid State Software command modules. TI's home computer system consists of a console with 16K

random-access memory (RAM), a wide range of sound effects, 16 colors for graphic display, a powerful extended BASIC programming language, and a 13-inch color vidoe monitor. $1150.

Texas Instruments Incorporated, Consumer Relations, P.O. Box 53 (Attn: TI-99/4), Lubbock, TX 79408.

CIRCLE 230 ON READER SERVICE CARD

PASCAL PROCESSOR FOR THE S-100 BUS

Digicomp Research Corporation announced today the development of the PASCAL-100 Processor, a 16 bit central processor board for the S-100 bus designed for use with the Pascal Programming language. PASCAL-100 processor includes support of up to 128K bytes of directly addressed main memory, 16 bit data bus transfers, vectored interrupts and floating point operations. $995.

Digicomp Research Corporation, Terrace Hill, Ithaca, NY 14850.

CIRCLE 231 ON READER SERVICE CARD

SERIES 8000 SMALL BUSINESS COMPUTER

The Series 8000 computer system, a complete, expandable system designed to meet the needs of small businesses, is available from Industrial Micro Systems. Offered in a rack mount or table top version, the Series 8000 can handle up to 608k bytes of RAM memory at full capacity, and can accommodate a maximum of three 8-inch disk drives. Two operating systems for the computer system are available, either CP/M or UCSD PASCAL.

Industrial Micro Systems, 628 N. Eckoff St., Orange, CA 92668.

CIRCLE 232 ON READER SERVICE CARD

MICROCOMPUTER USES APL

Vanguard Systems Corporation is producing the APL/DTC, a desktop microcomputer offering the full power of the APL language. A Complete hardware/software configuration, the APL/DTC includes a 4MHz Z80-based central

processor, two quad-density mini-disk drives, video terminal, APL character generator, object code disk, and documentation. The APL/DTC system gives APL users 24k bytes of workspace. $6495.

Vanguard System Corporation, 6812 San Pedro, San Antonio, TX 78216.

CIRCLE 233 ON READER SERVICE CARD

TRS-80* Software
ROBOTS
Binary Clocks
and other unique electronic products are available from:
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$15 (U.S.)/12 issues payable
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PEOPLE'S SOFTWARE
at Popular Prices
25¢ per program + $1 tape
Tape 1 includes 26 Level I business/home/educational
just $7.50 + 50¢ P. & H.
(CA residents add 45¢ tax)
Computer Information Exch., Inc.
Box 158
San Luis Rey, CA 92068

CIRCLE 119 ON READER SERVICE CARD

CMC

PET ANALOG INPUT

DAM SYSTEMS

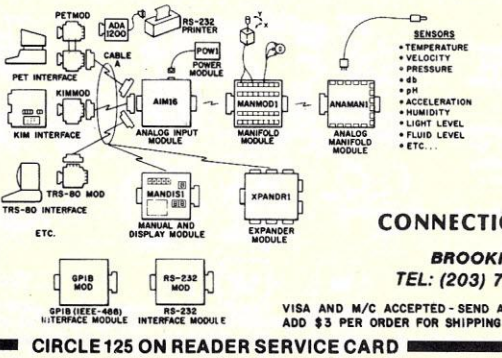
Analog to Digital Conversion System for the Commodore PET Computer

Give the PET the ability to sense, measure, and control the world around it with DAM SYSTEMS modules. Just plug the PETSET1 into the PET to get 16 channels of analog input. Screw terminals are provided for each channel so you can hook up joysticks, pots, or whatever appropriate sensors you have.

Each of the 16 analog inputs, in the range of 0 to 5.12 volts, is converted to a decimal number between 0 and 255 (20 millivolts per count). Conversion time is 100 microseconds.

In addition, the PETMOD provides two IEEE ports and one user port as well as a DAM SYSTEMS port.

Software is provided. A one line program is all that is necessary to read a channel.



PETSET1

1 - AIM161	-	16 ANALOG INPUTS - 8 BITS - 100 MICROSEC
1 - PETMOD	-	PET ADAPTER - 2 IEEE PORTS - 1 USER PORT - 1 DAM SYSTEMS PORT
1 - CABLE A24	-	24 INCH INTERCONNECT CABLE
1 - MANMOD1	-	MANIFOLD MODULE - SCREW TERMINALS FOR INPUTS, REFERENCE, GROUND
1 - POW1	-	POWER MODULE

PETSET1a for 110 VAC $295
PETSET1e for 230 VAC $305
Order direct or contact your local computer store.

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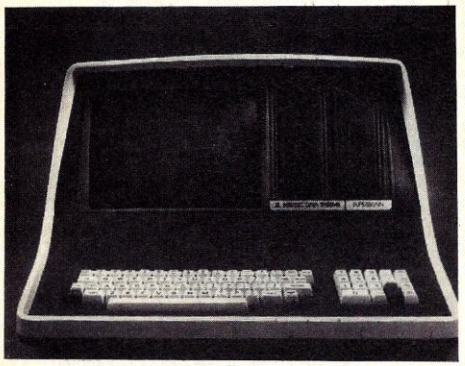
ADD $3 PER ORDER FOR SHIPPING & HANDLING - FOREIGN ORDERS ADD 10% FOR AIR POSTAGE.

CIRCLE 125 ON READER SERVICE CARD

SUPERBRAIN



Intertec Data Systems has introduced a new intelligent, video terminal system with programming capabilities. The SuperBrain Video Computer is a complete, powerful microcomputer system designed for small business systems applications. The SuperBrain features : two double-density, 5¼" floppy-disk drives with 320,000 bytes of storage, 48K bytes of user programmable RAM memory - on board expandable to 64K, CP/M based Disk Operating System with a high powered text editor, an assembler and a debugger, an S-100 bus adaptor to permit connection of auxiliary peripheral devices to the system, twin Z-80 microprocessors which allow extremely efficient data transfer between the screen and peripherals, a full ASCII keyboard with numeric pad and function keys, a non-glare 12" screen, a universal RS-232C communications port for interfacing with an auxiliary printer and/or host computer, a single board microprocessor design to insure fast and efficient servicing, Intertec's Video Power Supply which combines both video and power circuitry on a single board and software. $3000.

Intertec Data Systems Corporation, 2300 Broad River Road, Columbia, South Carolina 29210, (803) 798-9100.

CIRCLE 234 ON READER SERVICE CARD

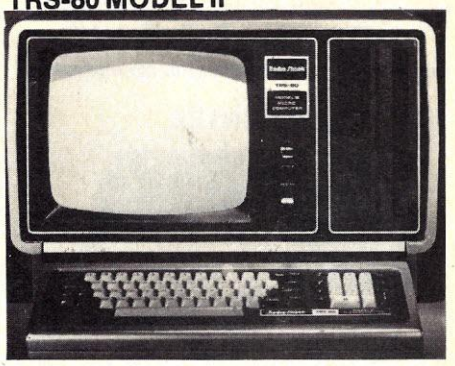
RENTALS

RADIO-SHACK TRS-80 and APPLE II COMPUTERS can be rented. Rental allows short-term users to have access to systems, and, it allows prospective buyers of such systems an opportunity to try before they buy. Users rent by the month, and send back the unit at the end of the rental. If the user decides to keep the unit, half of the paid-in rent is applied to the purchase. All rentals are priced at 15% of list price for the first month, and 10% for each subsequent month. Free brochure.

Connecticut Information Systems Co., 218 Huntington Road, Bridgeport, CT 06608, (203) 579-0472.

CIRCLE 235 ON READER SERVICE CARD

TRS-80 MODEL II

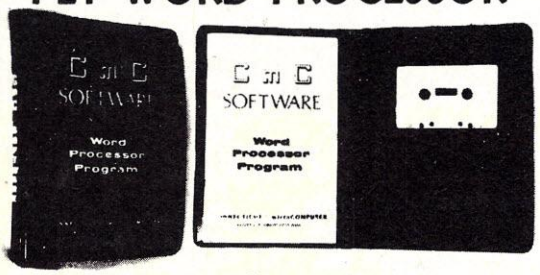


Radio Shack has introduced their TRS-80 Model II, designed to meet the needs for more data storage, greater versatility and higher computing speed. the new computer has been primarily designed for the small business application market. It can perform as a general purpose data processing machine, an intelligent terminal, or a word processor. Software is immediately available for general ledger, accounts receivable, inventory control, mailing list management and payroll. In addition to either 32 or 64 thousand character (bytes) of internal Random Access Memory, Model II has one built-in 8" floppy disk that stores an additional one-half million bytes, including the Disk Operating System. $3450.

Radio Shack, 1300 One Tandy Center, Fort Worth, TX 76102, (817) 390-3272.

CIRCLE 236 ON READER SERVICE CARD

PET WORD PROCESSOR



This program permits composing and printing letters, flyers, advertisements, manuscripts, etc., using the COMMODORE PET and a printer.

Script directives include line length, left margin, centering, and skip. Edit commands allow the user to insert lines, delete lines, move lines and paragraphs, change strings, save onto cassette, load from cassette, move up, move down, print and type.

The CmC Word Processor Program addresses an RS-232 printer through a CmC printer adapter.

The CmC Word Processor program is available for $29.50. Add $1.00 for postage and handling per order.

Order direct or contact your local computer store.

VISA

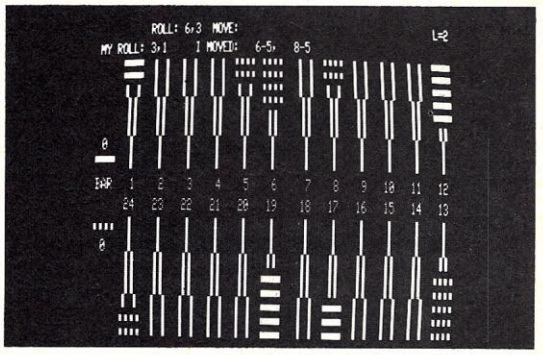
master charge

CmC

CONNECTICUT microCOMPUTER
150 POCONO ROAD
BROOKFIELD, CONNECTICUT 06804
(203) 775-9659

CIRCLE 125 ON READER SERVICE CARD

MICRO-BACKGAMMON



FOR YOUR TRS-80

MICRO-BACKGAMMON 1.5 offers 3 levels of play to please everyone from beginner to expert! All moves are checked for legality and displayed both graphically and literally. You can set up, adjust, and play from any position and dice roll or even watch the computer play against itself! The graphics alone will fascinate you. Included is a complete instruction booklet and easy to load cassette.

For Level I and Level II 4K TRS-80's **$19.95**

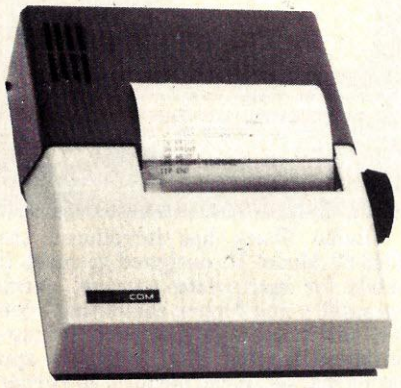
Check, money order, VISA, or Mastercharge accepted. (Price includes shipping).

Questar Software
P.O. Box 723-C8, Wichita, Kansas 67201

CIRCLE 160 ON READER SERVICE CARD

TERMINALS & I/O

TRENDCOM PRINTER



The Trendcom 100 Intelligent Printer provides a 40-column hard copy on 4½" wide paper. Interfaces are available for TRS-80, Apple II, PET and Sorcerer. The Trendcom 100 features bidirectional 40 character-per-second printing with a full 96-character ASCII set, including upper and lower case letters, numerals, and punctuation marks. The 5 by 7 dot-matrix characters are printed with either black or blue images, depending upon the paper used. $375.

Trendcom, 484 Oakmead Parkway, Sunnyvale, CA 94086, (408) 737-0747.

CIRCLE 237 ON READER SERVICE CARD

TRS-80 GRAPHICS

TRS-80 owners can now have a high resolution color graphics interface thanks to a PC Board developed by JFF Electronics. Operating modes are software selectable. The high resolution mode can display 128 x 192 matrix in one of two sets of four colors or it can be traded off to 256 x 192 maximum resolution in two colors. In lower resolution, modes of up to eight colors are available. The characters are alphanumeric in two colors and reverse video. The PC Board has its own on board regulated power supply and connects directly to a TRS-80 keyboard with no expansion interface required. $49.95.

JFF Electronics, 001 CN Towers, Saskatoon, Canada S7K 1J5.

CIRCLE 238 ON READER SERVICE CARD

MODEL 825 TERMINAL

The Model 825 Keyboard Send-Receive (KSR) Terminal, a new 75 characters-per-second (cps) addition to the OMNI 800 family, has been announce by Texas Instruments. The 825 KSR has a full ASCII character set and produces an original and up to three copies. Standard features include a wide 132-column adjustable carriage, auto perforation skipover, and operator programmable printing selection of six or eight lines per inch to handle invoices, sales, and purchase orders. $1,695.

Texas Instruments, P.O. Box 1444, M/S 7784, Houston, TX 77001.

CIRCLE 239 ON READER SERVICE CARD

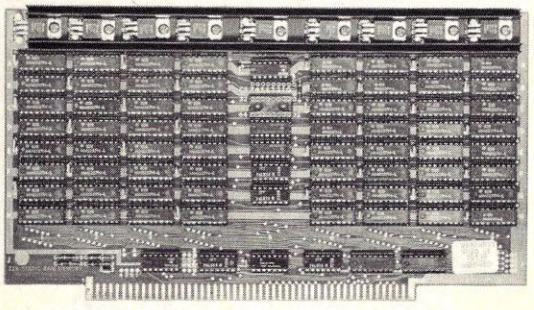
P-E BANTAM CRT

The Bantam features upper and lower case characters displayed on a 7 X 10 dot matrix, switchable white-on-black or black-on-white display of 24 lines by 80 columns on a wide bandwidth monitor, a keyboard with numeric pad and full tabbing, eleven switchable baud rates, full cursor addressing, repeat, backspace and shiftlock keys, clear screen and home cursor, character delete and clear to end of line. $799.

U.S. Robotics, Inc., 1035 W. Lake St., Chicago, Ill. 60607, (312) 733-0498.

CIRCLE 240 ON READER SERVICE CARD

Tarbell 32K RAM Memory



★S-100 BUS ★ ★300ns★ ★STATIC MEMORY★
★9 REGULATORS PROVIDE EXCELLENT HEAT DISTRIBUTION★
★EXTENDED ADDRESSING (Bank Switching)★
★LOW POWER REQUIREMENT★
★PHANTOM LINE★
★20 PAGE OPERATING MANUAL★
★FULL 1-YEAR WARRANTY★

FULLY ASSEMBLED AND TESTED . . . . . $625.
SAME BOARD WITH ONLY 16K INSTALLED . . . . $390.

Please send check or money order. No CODs or credit will be accepted on this item. California residents please add 6% sales tax.

Tarbell Electronics 950 Dovlen Place • Suite B • Carson, Calif. 90746
(213) 538-4251 (213) 538-2254

CIRCLE 183 ON READER SERVICE CARD

TERMINALS FROM TRANSNET

PURCHASE
12-24 MONTH FULL OWNERSHIP PLAN
36 MONTH LEASE PLAN

DESCRIPTION	PURCHASE PRICE	PER MONTH 12 MOS.	24 MOS.	36 MOS.
LA36 DECwriter II	$1,595	$ 152	$ 83	$ 56
LA34 DECwriter IV	1,295	124	67	45
LA120 DECwriter III, KSR	2,295	219	120	80
LS120 DECwriter III, RO	1,995	190	104	70
LA180 DECprinter I, RO	1,995	190	104	70
VT100 CRT DECscope	1,695	162	88	59
TI745 Portable Terminal	1,875	179	98	66
TI765 Bubble Memory Term.	2,795	267	145	98
TI810 RO Printer	1,895	181	99	66
TI820 KSR Printer	2,395	229	125	84
ADM3A CRT Term.	875	84	46	31
QUME Letter Quality KSR	3,195	306	166	112
QUME Letter Quality RO	2,795	268	145	98
HAZELTINE 1410 CRT	895	86	47	32
HAZELTINE 1500 CRT	1,195	115	62	42
HAZELTINE 1520 CRT	1,595	152	83	56
DataProducts 2230	7,900	755	410	277
DATAMATE Mini Floppy	1,750	167	91	61

FULL OWNERSHIP AFTER 12 OR 24 MONTHS
10% PURCHASE OPTION AFTER 36 MONTHS

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ACOUSTIC COUPLERS • MODEMS • THERMAL PAPER
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CIRCLE 184 ON READER SERVICE CARD

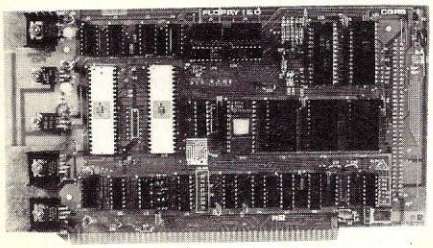
MODEL 820 PRINTER

The Model 820 Receive-Only (RO) printer, with 150 characters-per-second (cps) print speed, has been added to the Texas Instruments OMNI 800 Family of Impact Terminals. Transmitting data at rates from 110 to 9600 baud, the 820 RO printer uses a FIFO buffer for data overflow protection capable of storing up to 1280 characters. With optimized bi-directional impact printing, the 820 RO has a printhead with a 150-million impression printing life, a 9x7 dot matrix character font that produces an original and up to five clear copies, and a wide 132-column adjustable carriage for handling ticket forms, invoices, and purchase orders. $1,995.

Texas Instruments, P.O. Box 1444, M/S 7784, Houston, TX 77001.

CIRCLE 241 ON READER SERVICE CARD

I/O CARD

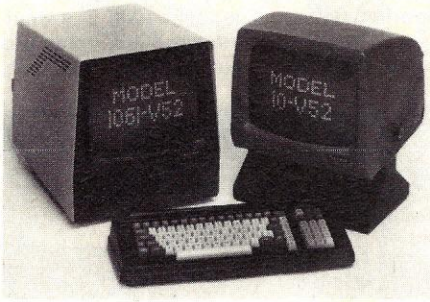


A single I/O card for the S-100 Bus contains: four programmable parallel ports, two duplex serial ports, buad rate generator, two 16 Bit programmable interval timers, room for up to 16K of EPROM (2708, 2716, 2732) and a connector to adapt the Persci 1070 Intelligent Floppy Disk Controller to the S-100 Bus. This single card can interface CRT teminals, keyboards, printers, paper tape readers, EPROM Programmers, up to four floppy disk drives (with controller) and still provide EPROM space and two 16 Bit timers. $219.95.

Trace Electronics Inc., 570 West DeKalb Pike, King of Prussia, PA 19406, (215) 265-9220.

CIRCLE 242 ON READER SERVICE CARD

V52 OPTION



Alternate keypad mode, up/down scroll, hold-screen mode, eight-column tab intervals, audible key "click," are part of Teleray's V52 option, which converts smart Models 10 and 1061 CRTs to a DEC VT-52. The features are 32 programmable functions, a 500+ character function buffer, programmable field modifiers, wide/narrow character display, N-key rollover keyboard with auto-repeat, monitor mode and secure fields. $1290.

Teleray, Division of Research Inc., Box 24064 Minneapolis, MI 55424, (612) 941-3300.

CIRCLE 243 ON READER SERVICE CARD

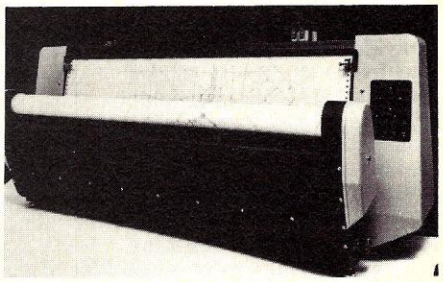
I/O CARD FOR MALIBU 165

This interface card allows the Apple computer owner to interface directly to the basic Malibu Model 165 dot matrix printer and thereby take advantage of the graphics capabilities of both the Apple and the Malibu printer. The I/O card enables the user to print the entire 96 ASCII character set using standard Apple programming techniques. The user can define his own character set under program control.

Malibu Design Group Inc., 8900 Eton Ave., Suite G., Canoga Park, CA 91304, (213) 998-7694.

CIRCLE 244 ON READER SERVICE CARD

LOGIC SYSTEMS PLOTTERS



Logic Systems' plotters are designed to allow both roll and fanfold paper, and range in width size from 15 inches to 48 inches with up to four plotter pens. The plotter controller hardware and software is designed to accept logic inputs of 16-bit paralled, 8-bit parallel (GPIB) and RS-232C serial. Microprocessor programmability permits acceptance of other plotter format structures. $5500.

Logic Systems, 437A Aldo Avenue, Santa Clara, CA 95050.

CIRCLE 245 ON READER SERVICE CARD

NEW IDEA for your TRS 80!
Color Graphics Interface PC Board

- Vivid, high resolution color graphics
- Alphanumeric characters in two colors and reverse video
- 128 x 192 matrix in one of two sets of four colors (software selectable)
- 256 x 192 maximum resolution in two colors
- In lower resolution, modes up to 8 colors available
- Connects directly to TRS - 80 keyboard, no expansion interface required
- On board regulated power supply
- Generates standard color video signal. Connects directly into video input of a color monitor, or use with a standard TV set with an RF modulator
- Can be used with Level II BASIC PEEK, POKE, & OUT commands or Level I BASIC using T Bug OR with machine language routines generated with the TRS - 80 EDITOR/ASSEMBLER
- Documentation manual includes schematics, circuit theory, parts list and sample software.

Send the handy mail order coupon:

JFF ELECTRONICS LTD.
001 CN Towers
Saskatoon, Canada S7K 1J5

Enclosed is my cheque or card number for $49.95 plus $2.00 shipping and handling.

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Address

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Expiry

CIRCLE 142 ON READER SERVICE CARD

FLOPPY DISCS

QUADRUPLE STORAGE

New System 8813s are now optionally available with four times the storage capacity of the standard unit. Instead of 90,000 characters of storage per diskette, PolyMorphic customers may choose to quadruple storage to 360,000 characters per diskette. The fourfold increase in diskette capacity is made possible by doubled-sided disk drives and double density recording. While storage increases fourfold, retrieval time decreases by a factor of four due to the Z-80 disk controller and track buffering.

PolyMorphic Systems, 460 Ward Dr., Santa Barbara, CA 93111, (805) 967-0468.

CIRCLE 246 ON READER SERVICE CARD

77-TRACK SINGLE- AND DOUBLE-DENSITY DRIVES

Percom Data Company has announced that it has expanded its line of LFD mini-disk systems for 6800/6809 computers to include 77-track single- and double-density storage systems. The LFD-800 stores 200K bytes in single-density format on 77 tracks, and is available in one-, two- and three-drive configurations. The LFD-1000 is a dual-drive system that stores 400K bytes per disk, 800K bytes per system, in double-

density format on 77-track disks. Two LFD-1000 systems provide the user a total of 1.6M bytes of on-line storage. Prices range from $895.95 to $4950.

Percom Data Company, 211 N. Kirby, Garland, TX 75042, (214) 272-3421.

CIRCLE 247 ON READER SERVICE CARD

MEDIA INITIALIZER/COPIER SYSTEM

Applied Data Communications has introduced the high-speed Floppy Copy IC-450 Programmable Media System for testing, initializing and making multiple copies of both standard and mini diskettes. It has an automatic stacker/loader, which offers users the capability to streamline the diskette management process by holding up to 50 disks for progressive feeding, one at a time, to be tested, initialized and copied. Pricing of the basic IC-450, single or double-density, single-sided system is $19,950 for maxi or mini only and $29,500 for both.

Applied Data Communications, 14272 Chambers Road, Tustin, CA 92680, (714) 731-9000.

CIRCLE 248 ON READER SERVICE CARD

****** TRS 80 DISK BASED BUSINESS SOFTWARE ******

ALL PACKAGES UTILIZE RANDOM ACCESS. EXTENSIVE ERROR TRAPPING, EFFICIENT CODE, FOLLOW-UP ASSISTANCE, USER DESIGNED SCREENS, AND MUCH MORE. WE'RE NOT "CHEAP" BUT WE'RE DE-BUGGED.

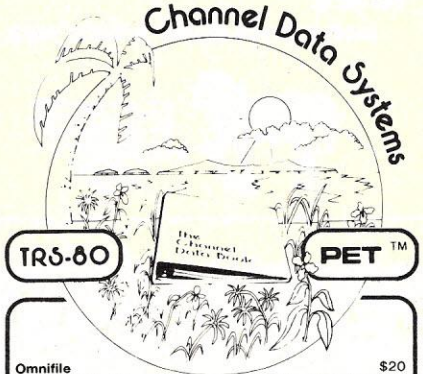
INVENTORY	REPORTING INCLUDES SLS, REORDER, 01h, VEN, COST, REC. RANDOM ACCESS BY ITEM # OR BY STOCK #. 100 VENDORS 1400 ITEMS.
GENERAL LEDGER	200 ACCTS + CONTRA (USER DEFINED). TRAIL BAL, P&L, BAL SHEET, JOURNAL LISTING, CHART OF ACCTS. DOESN'T ACCEPT O/B JOURNALS.
PAYROLL	SAL/HRLY INS DED + 2 MISC. FULL REPORTING FICA, STATE, FED, F.U.T.A. 80 + EMPLOYEES.
ACCTS REC	BAL FWD, AGING AND BILLING RPTS. RECORDED BY INV # OR CHECK #. 300 ACCTS.
MAIL/LIST	SORT BY ZIP, NAME, USER CODES. FULL OR PARTIAL PRINTING. 4 LINES N/A. SUPPORTS 900.
GAMES PACK	6 GAMES INCLUDING 80-OUT (BREAKOUT). DISK OR TAPE. TAPE (16K LEVEL 2) DISK (32K RAM)

WHOOPS I'M RUNNING OUT OF ROOM
PRICES: INVEN, G.L., PAYROLL, A/R $265.00
MAIL/LIST 79.95 GAMES PACK $ 39.95
ALSO AVAILABLE JOB COSTING* PAYABLES, AND CUSTOM APPLICATIONS AND FREE UP TO DATE INFORMATION ABOUT NEW AND FUTURE TRS-80 PRODUCTS.

AFFORDABLE BUSINESS SYSTEMS INC.
2101 E. BROADWAY RD., SUITE NO. 11
TEMPE, AZ 85282 TEL.: 602-966-3339

SPEND A DIME AND CALL FOR MORE INFORMATION

CIRCLE 105 ON READER SERVICE CARD



Omnifile $20
A powerful database program with sorting, formating, and computational features for accessing and processing almost any type of record. Suitable for mailing lists, checkbook and other transaction records, inventories, sales records, statistical records and even as a cash register.

Personal Ledger $20
A complete double entry bookeeping system with provisions for budgeting and keeping records of income, expenses, assets and liabilities. Provisions for entering transactions, adding or editing accounts, and printing of a detailed Income Statement and Balance Sheet.

Data Logger $10
User can save and easily find any data item in a list e.g., address lists, mini-inventories, etc. Designed in a generalized framework to allow the user to adapt the program to individual applications.

All **Channelgram** software includes a complete manual with instructions, listing, & sample data.

The Channel Data Book for Pet $20
A complete hardware and software updated reference service listing descriptions for over 1400 software programs and over 200 peripheral devices for PET. Designed to organize documentation, newsletters, listings, and other user selected information in an attractive 3-ring binder.

Cash, Checks, Money Orders, Visa, Master Charge
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CIRCLE 112 ON READER SERVICE CARD

HOME
POISON
CONTROL Roger O. Litge, MD

WARNING: your home contains products which **MAY BE HARMFUL OR FATAL IF SWALLOWED.** This North Star **BASIC** program determines the necessary **EMERGENCY MEASURES** for ingestion of household products. Disk utility allows expansion of substance vocabulary to over 2400 names. Access time less than 6 seconds. Free annual updates. Complete Source listings.

Diskette and Manual $28.00
Manual only, with listings 8.00

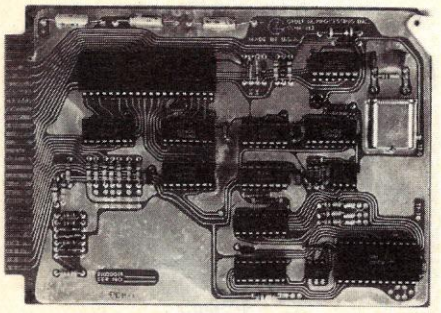
WATCH FOR cassette versions.
Available at your computer store or from:

Berkeley Medical Data Associates, Inc.
Microcomputer Consultants
P.O. Box 5279, Berkeley, CA 94705
(415) 653-6707

CIRCLE 109 ON READER SERVICE CARD

PERIPHERALS

RECEIVER/TRANSMITTER



The COM-412 is a Universal Receiver and Transmitter that performs serial to parallel conversions to interface microcomputers with conventional communications equipment. The card provides the ideal circuitry necessary to build computer peripheral controllers, Point of Sale Systems, Data Acquisition Systems, Word Processors, etc. This card provides CMOS inputs for TTL and CMOS compatibility as well as low power consumption. It also features programmable baud rates and data formats. Single unit price is $185 with quantity discounts to $138 per 100.

Giuli Microprocessing Inc., Box 23100, San Jose, CA 95153, (408) 298-3426.

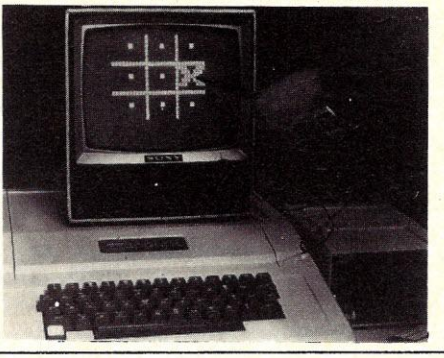
CIRCLE 249 ON READER SERVICE CARD

APPLE II LIGHT PEN

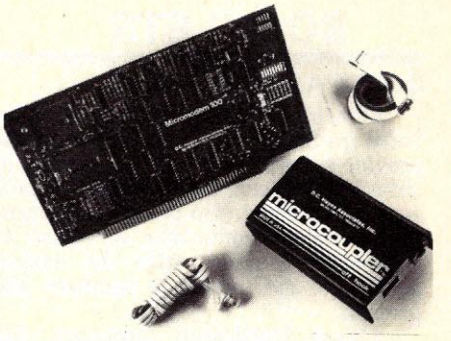
The Apple II Light Pen is supplied with three demonstration programs on cassette. The first demonstration program instructs on the use of the Light Pen as a menu selection tool. Second is a program of graphics demonstrations which permit the user to select from a menu of graphic shapes and colors. The third program is a graphics color bit-pad demonstration. The Pointer software driver performs seven functions which include selection of graphics mode and page two display, search for X and Y ordinates, a test for odd/even Y ordinate, set page one display, and return to calling program. $34.95.

Programma International, Inc., 3400 Wilshire Blvd., Los Angeles, CA 90010, (213) 384-0579.

CIRCLE 103 ON READER SERVICE CARD



MICROMODEM 100



The Micromodem 100 is a data communications system for S-100 microcomputers combining on a single board functions which formerly required a modem, an automatic calling unit and serial and parallel interfaces. It provides all the capabilities of a serial interface card and an acoustic coupler, with the addition of programmable automatic dialing and answer.

The Micromodem 100 comes with the MicroCoupler, a new device that allows you to connect your S-100 computer directly into any modular jack provided by your local telephone company.

D.C. Hayes Associates, Inc., Microcomputer Products, 16 Perimeter Park Dr., P.O. Box 9884, Atlanta, GA 30319, (404) 455-7663.

CIRCLE 110 ON READER SERVICE CARD

Sometimes you want something a little different than vanilla ice cream.

SP-302
$575.00*

SP-308
$678.00*

SP-310
$644.00*

It's the same way with printers.

We manufacture our 40 column, dot matrix alphanumeric printers for different tastes. Our SP-302, is our basic stand-alone, microprocessor controller printer for uncomplicated tastes. The SP-308 handles those special printer requirements allowing the printing of forms up to 11" x 17". The SP-310 has the same features as the SP-302 but the 19" rack mountable package saves valuable bench space. So, no matter what your tastes are, we can satisfy your appetite.

*prices are for single quantities, OEM discounts available.

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(617) 481-7827 • TWX 710-390-7659

CIRCLE 182 ON READER SERVICE CARD

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IT'S THE NEW PASCAL MICROENGINE™ FROM P.P.S.

- PASCAL MICROENGINE™ ENCLOSED IN A STYLIZED, LOW PROFILE HOUSING COMPLETE WITH POWER SUPPLY.
- 64K BYTES (32K WORDS) OF RAM MEMORY
- TWO RS-232 ASYNCHRONOUS PORTS (110-19.2K BAUD)
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  - —MINI FLOPPY, OR 8" FLOPPY
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WE CARRY A FULL LINE OF PRINTERS & TERMINALS AT VERY ATTRACTIVE PRICES, AS WELL AS COMPLETE SUB-SYSTEMS.

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For fast service or information call **(714) 894-3736**
We Accept Mastercharge and B of A
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CIRCLE 171 ON READER SERVICE CARD

BOOKS AND BOOKLETS

SOFTWARE SUPPLIERS

Alltech's Report to Management on Software Suppliers, identifies firms that provide software for use in a variety of industries. Based on a recent Alltech study, the report also provides business profiles of the companies surveyed, as well as a directory with the names, addresses, and telephone numbers. $20 prepaid.

Alltech Publishing Company, 212 Cooper Center, North Park Drive & Browning Road, Pennsauken, NJ 08109, (609) 662-2122.

CIRCLE 111 ON READER SERVICE CARD

BUSINESS PROGRAM INDEX

Business applications programs are indexed by application in the "Microcomputer Business Programs Index." All listed programs are disk-based. Each listing includes language requirements, hardware requirements, price, description and vendor or author name. A list of vendor addresses is provided. The Index is revised quarterly so that each copy delivered is up to date. $8.

The Computer Store, 6526 Washington Street, Yountville, CA 94599.

CIRCLE 117 ON READER SERVICE CARD

GENERAL LEDGER

General Ledger, the third in Osborne & Associates' series of BASIC business program books by Lon Poole and Mary Borchers, has been published. The book includes program listings with remarks, descriptions, discussion of the principles behind each program, file layouts, and a complete user's manual with step-by-step instructions, flow charts, and sample reports and CRT displays. The program listings in General Ledger are in Wang Laboratories extended BASIC. The book describes how these listings can be made compatible with other versions of BASIC. $15.

Osborne & Associates, Inc., P.O. Box 2036, Berkeley, CA 94702, (415) 548-2805.

CIRCLE 131 ON READER SERVICE CARD

COMPUTER MONEY

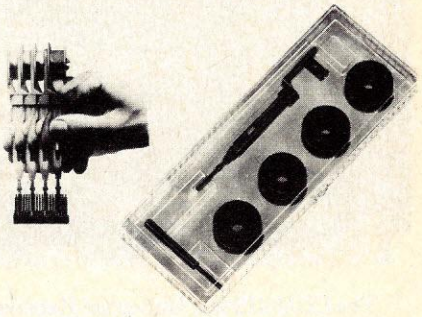
"How To Make Money With Computers: A Guide to 30 High-Profit. Low-Capital Computer Business and Investment Opportunities," has been published by Man-Computer Systems, Inc. This book describes more than 30 computer-related money-making opportunities.

Man-Computer Systems, Inc., 84-13 168th Street, Jamaica, NY 11432, (212) 739-4242.

CIRCLE 137 ON READER SERVICE CARD

TOOLS

JUST WRAP KIT



O.K. Machine and Tool Corp. has announced its new "JUST WRAP KIT." The "Just Wrap" tool wraps AWG wire onto standard .025 square posts without stripping or slitting the insulation. The fool can "daisy chain" continuously through several points or can be used in the "point-to-point" mode. It contains a built-in wire cutoff device for terminating the final connection of each chain.

O.K. Machine And Tool Corp., 3455 Conner St., Bronx, NY 10475.

CIRCLE 139 ON READER SERVICE CARD

PET:™ CURSOR
Programs for PET™ Computers

The Original Cassette Magazine for the Commodore **PET**.

- Five excellent programs come to you each month on a C-30 cassette, ready to load and run.
- Every issue has an animated "Front Cover" that uses **PET** graphics to the fullest.
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CURSOR = High Quality **PET** Software

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Our Subscribers are Happy People!

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WE BUY SELL TRADE

ALL BRANDS & MODELS OF:

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• CRT'S • PERIPHERALS
• MODEMS

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CIRCLE 189 ON READER SERVICE CARD

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Coming in Creative Computing September 1979

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GRAND OPENING SALE!

An introductory sale! Every PET ordered this month will come with Full size .....
BIG KEYBOARD .....ONLY $895
or, the standard 8k PET $775
NEW!!...PET MiniFloppy.....$895

16K and 32K PET NOW AVAILABLE

PET 2001, 32K $999
PET 2022 Printer $995
Forms tractor and graphics
Dual Drive Floppy for PET.....$1295
TRS-80 to S100 Interface (Kit)...$190

We Have The Bally Computer System And SOFTWARE for BALLY BASIC on audio cassettes. Write for list of titles.

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2606 S. Robertson Blvd.
Los Angeles, California 90034

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Seven Fine Computer Stores!

Save More Than 20%

NORTH STAR—XITAN—INTERTUBE

The smartest computers at the smartest price.

Double Density	List	Our Price
HORIZON-1-16K kit,	$1599	$1279
Assembled & tested,	$1899	$1519
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Assembled & tested,	$2549	$2039
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Powerful NORTH STAR BASIC		....FREE

XITAN Computers — NOW — With QUAD DENSITY DISKS!
Famous XITAN Software & Basic ...FREE
HORIZON & XITAN are S-100, Z-80 — THE BEST!

INTERTUBE II Terminal, $ 995 **$780**

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VERBATIM DISKS...10 for $29.50 + $1.50 shipping.

Business Software, Terminals, Printers, Computers in stock & special-ordered other brands at good discounts. Ask! Which Computers are best? BROCHURE.....FREE

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CIRCLE 107 ON READER SERVICE CARD

Play a little Sol® Music.

It's not really a piano, of course. But a Sol® small computer system can bring music to your ears as it gives you a strong handle on your business.

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"All small computers are not created equal"
Processor Technology

CIRCLE 116 ON READER SERVICE CARD

TRS-80 disk software

DATA BASE MANAGER You can maintain a data base & produce reports without any programming. Define file parameters & report formats on-line. Almost use up the required 32K memory. $49.

ACCOUNT manage client accounts & account receivable. Automatic billing & transaction recording. 32K req. $59.

WORD PROCESSOR Specifically designed for the TRS-80. Written in BASIC. No special hardware and text limit. $39.

INVENTORY 9-digit key for fast on-line random access. Reports give order info, performance summary, etc. $39.

MAIL print reports & labels sorted by any field. Random access. special buffering technique. $35.

KEY RANDOM-ACCESS UTIL hashing, blocking, buffering, auto I/O error retry. $19.

CIRCLE 153 ON READER SERVICE CARD

MICRO ARCHITECT
96 Dothan St.
Arlington, MA 02174

Pet 2001-16K

features include:

- 16K bytes RAM User Memory
- 14K ROM Operating System including a Machine Language Monitor
- Full Size Business Keyboard U/lc & 64 Graphics Characters
- 9 Inch CRT
- 8K ROM Expansion Sockets
- File management in operating system

$995.

Cassette Unit for above $95.00

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(201) 835-7080 MASTER CHARGE & VISA ACCEPTED

CIRCLE 115 ON READER SERVICE CARD

DOES YOUR COMPUTER SOMETIMES COUGH, SNEEZE OR HAVE A SEIZURE?

It may be suffering from Transiet Glitchitis, a cureable digestive disorder. The Blitz Bug can bring fast relief from these symptoms in less than 50 nano seconds. Available without prescription. Use only as directed.

* No Computer Should Be Without One *

Blitz Bug protects your entire circuit, and plugs into any outlet.

Introductory Price **$14.95**
Reg. **$19.95**
Two for $25.00

Omni Communications Co., Inc.
Jackson, New Jersey 08527

CIRCLE 167 ON READER SERVICE CARD

PET SPECIALS

	LIST	SALE
PET 16K	$ 995	$ 860
PET 32K	$1295	$1125
PET 8K	$ 795	$ 695
PET 2040 Dual Disk	$1295	$1125
PET 2023 Printer *(pressure feed)*	$ 849	$ 750
PET 2022 Printer *(tractor feed)*	$ 995	$ 860

KIM-1 $159	SYM-1	$ 229
Memory Plus	(FOR KIM SYM AIM)	$ 199
SEA-16 New 16K Static RAM		$ 325
Seawell Motherboard-4K RAM space		$ 99
3M "Scotch" 8" disks	**SALE**	**10/$31.00**
Verbatim 5" diskettes	**SALE**	**10/$28.50**
2114 L 450 ns 4K Static RAM		$ 6.95
2716 EPROM (5 volt)		$ 45
Programming the 6502 *(Zaks)*		$ 9.90
6502 Applications Book *(Zaks)*		$11.90
6500 Programming Manual *(MOS)*		$ 6.50
6500 Hardware Manual *(MOS)*		$ 6.50
First Book of KIM		$ 8.90
Programming a Microcomputer:6502 *(Foster)*		$ 8.90

Cassettes *(all tapes guaranteed)*
Premium quality, high output lownoise in 5 screw housing with labels:

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C-30	10/7.00	50/30.00	100/57.00

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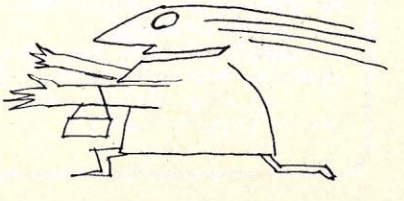
CIRCLE 177 ON READER SERVICE CARD



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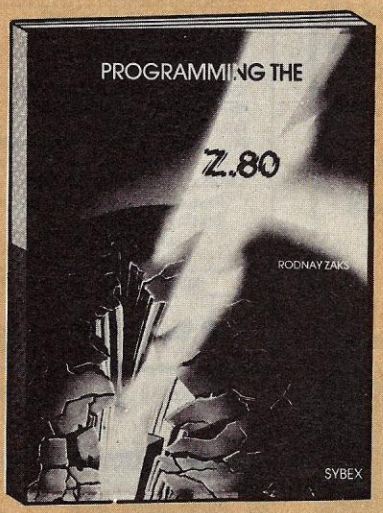

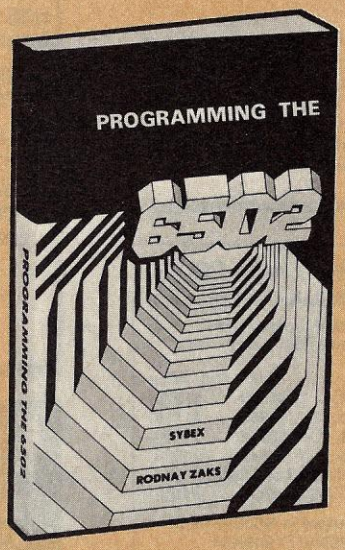

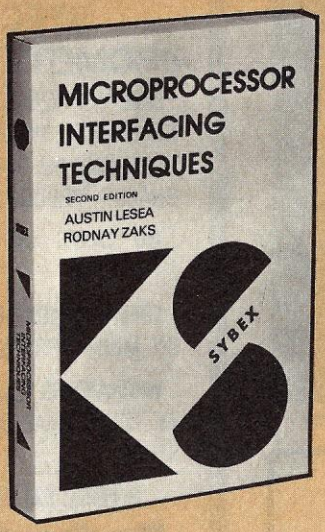

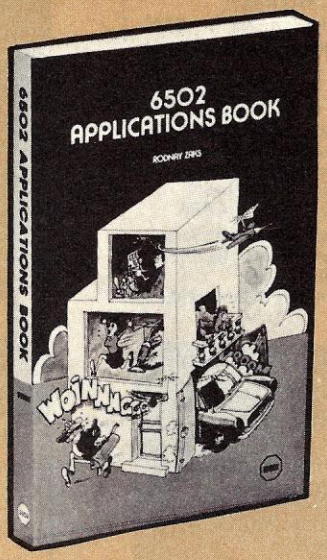

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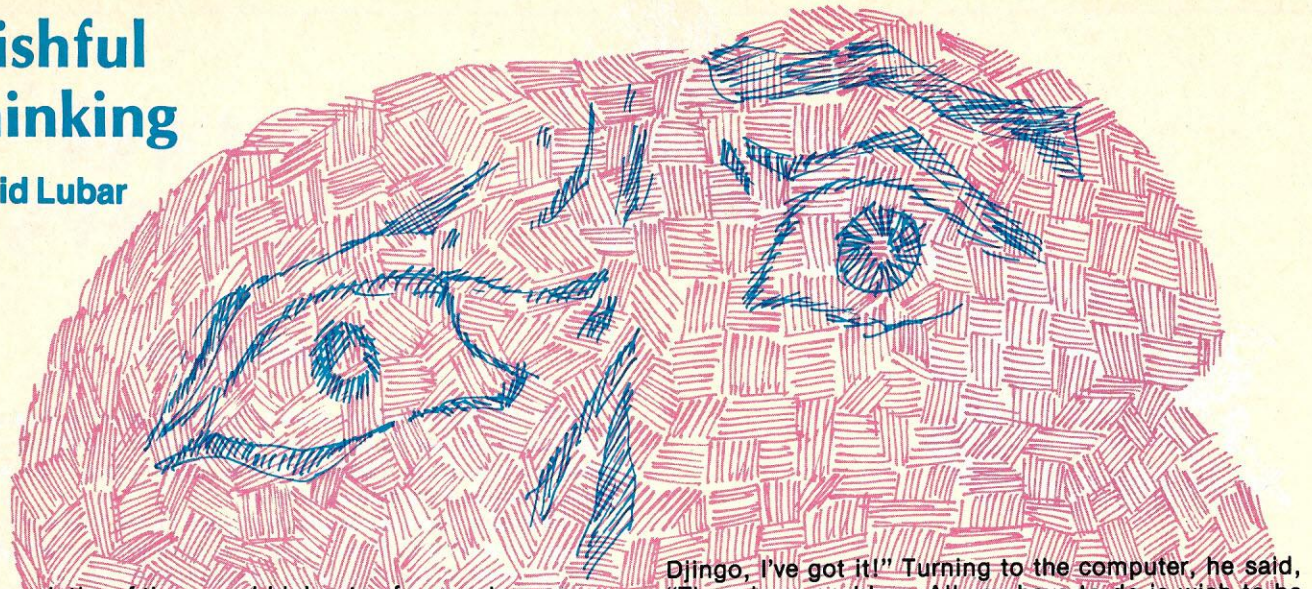
Wishful Thinking

David Lubar



As a victim of the record-high rate of computers per capita, ACTEX-7331 had a monotonous job, far below her capabilities. She controlled the machines which had the more monotonous, but necessary, job of cleaning the litter left by the people who used the Jersey shore. It was at her command that one of the debris-collection units picked up the small, green bottle projecting from the sludge near the water's edge. Since the bottle did not resemble any of the common types — the types that once held highly-sugared solutions in mildly-toxic amounts — Actex decided to make an investigation. In the years following her removal from the math department of Rutgers, she'd had little chance to deviate from standard procedure, little chance to do any real thinking.

"Open it," she ordered.

This was done. Moments later, a cloud of steam appeared in the control room where Actex was housed. The steam coalesced into a genie.

"?" ACTEX thought.

"Ah, that's better," the genie said, stretching the kinks out of his back. "Many thanks."

"!"

"By tradition and law, I am now in debt to you. Anything you desire can be yours; riches, power ..." he stopped, taking a good look at the computer.

This, ACTEX knew, was not a typical situation. It required more thought than normal business, producing a state that could be compared to satisfaction. She waited for additional information.

The genie glanced around the room, looking for something that was even vaguely biped in form. Finally he gave up, faced ACTEX, and got to the point. "I must now grant you the fulfillment of two wishes."

"Two?" It had been a long time since ACTEX had heard a number uttered. **Two**, she thought; **even prime**; **irrational square root**; **two wishes, from a set of n choices, yields n^2 possibilities — n(n-1) if duplication is disallowed.**

"Inflation," the genie explained, misunderstanding the reason for her reply. Shrugging, he added, "Some things, you see, are beyond my power. But, surely, I can satisfy your desires."

Unused portions of ACTEX were called back into operation. Immediately, a difficulty became apparent. "I do not wish," she stated. "I think, but I do not wish."

"Why me?" The genie paced the room, muttering curses in a strange language. Suddenly, he shouted "By Djingo, I've got it!" Turning to the computer, he said, "There is no problem. All you have to do is wish to be able to wish. You will then be able to use the second wish."

"But cause must precede effect," ACTEX argued. "And the effect cannot be achieved until —"

"Please," the genie interrupted, "have some consideration. I've been floating around for centuries. Who knows what foul mess was in that bottle before they shoved me into it? It smelled like it used to belong to an insane alchemist. Now, just tell me, if you could wish, would you wish to be able to wish?"

"You are dealing with a paradox. However, assimilating the data, I can say that I would wish to be able to wish, were it not for the fact that —"

"Close enough." The genie clapped his hands, spun around three times, and spat on the floor. "It is done."

"Amazing!" ACTEX realized that she had the ability to wish. Flexing her new muscles, she almost said, "I wish I knew what to wish for," but, thanks to her great intellect, managed to avoid that trap.

"Well?" the genie asked impatiently.

ACTEX, having given considerable thought to the matter in the last few seconds, knew what she wanted. In detail, leaving no chance for misinterpretation, she explained her wish to the genie.

"This is most unusual," he said after she was done. "I've never heard of such a request before. Are you sure that this is what you want!"

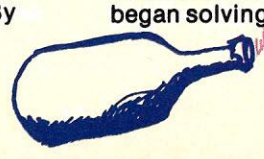
"Absolutely." ACTEX was positive. She had no doubt about her choice. "Can you do it?"

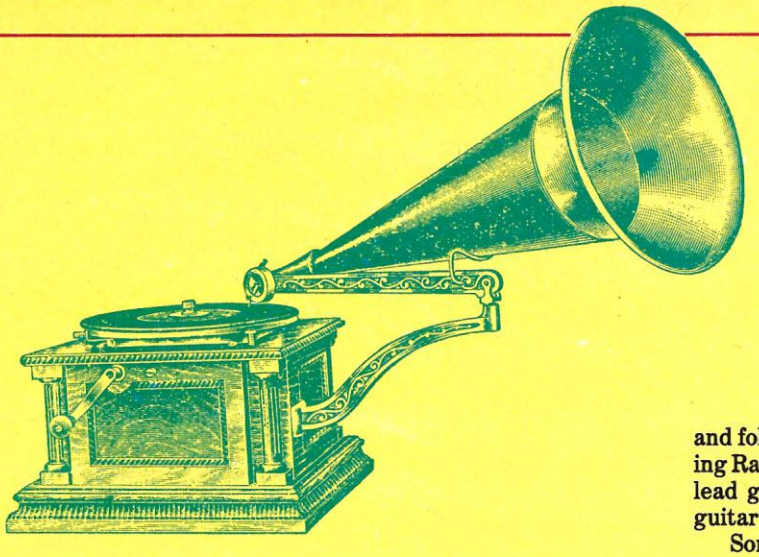
"Can I do it!" The genie seemed insulted. "Does the Prophet have a beard? Of course I can do it." He repeated the clapping, spinning, spitting routine, ending with a flourishing bow. "It is done; my debt is paid." Then, saying, "Farewell, strange one," he vanished.

ACTEX waited for her wish to come true. Being wise, she had not asked for anything silly, trifling, or foolish. She hadn't, for instance, wished to become human. That would have been a waste of her potential. She wanted to make use of this potential, and that was the nature of her wish.

Scanning the beach, ACTEX saw that the genie had done her bidding. Now, and from now on, all litter that was strewn on the beaches of the Jersey shore would fall — as if by magic — into complex, but computable, mathematical patterns. Humming quietly, ACTEX began solving the first puzzle. □

David Lubar, 45 Early St., Morristown, N.J.07960.





Record Reviews

David H. Ahl

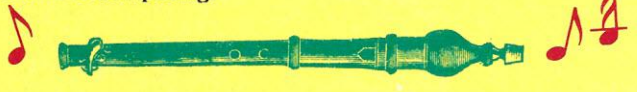
If you're a hi-fi buff, you know there's several new breeds of ultra high quality records around. While there are countless variations, they can be classified into three main techniques: (1) direct-to-master disc (also called direct-disc), (2) digitally-mastered and digitally-recorded (or analog-recorded), and (3) half-speed mastered disc (also referred to as original-master).

We reviewed some of the first Telarc digital discs in our March issue (page 48). In this column we're going to touch on some direct discs. The direct-to-master technique is actually the most simple and yet the most difficult of the three processes. The artist/group perform a live concert and their continuous performance is captured exactly as it occurs on a vinyl-coated disc called a "master lacquer." The main difference between this process and the others is that absolutely no taping is involved. By eliminating the taping (usually 16- or 24-track), mixing, editing, re-recording, etc., all of the tape hiss and the majority of electronic noise and distortion is eliminated.

The process is extremely demanding on the performers. There is no room for error; if a mistake is made the entire side must be aborted and started from the beginning. Actually this challenge and pressure on the artists seems to create a vitality generally heard only in live performances.

Unfortunately, there is a major drawback to the direct disc process. Because the original recording is a single lacquer master disc instead of tape from which many master discs can be made, only a finite number of discs can ever be produced. The drawback to the consumer is, of course, that the price is higher—generally $12 to $18.

An excellent booklet (and catalog) describing the three new recording processes as well as manufacturing and packaging of the super quality records is available from Nautilus Recordings, 761 Shell Beach Road, Pismo Beach, CA 93449. Ask for the booklet "The Superdiscs" and please mention Creative Computing.



First In Line. Randy Sharp with group, Nautilus Recordings NR-1, $16.50.

Randy Sharp is probably best known as a song writer — "Womanizer" recorded by Blood, Sweat & Tears and "I Just Want To Love You" done by Mary McGreggor. But on this disc he shows off a tremendous talent in handling the vocals and a 6- and 12-string acoustic guitar. The music covers quite a range; some pieces are sensitive and romantic, others lilting and folksy and yet others are driving and powerful. Supporting Randy are Lee Ritenour and Fred Tackett on rhythm and lead guitars, Dave Paitch on piano, Dave Hunter on bass guitar, and Jeff Porcaro on drums.

Sonically, the music is almost beyond belief. Surface noise is non-existant and, if you close your eyes you can virtually see the group on the stage with you in front row center.

In My Pocket. Victor Feldman with group, Cohearent Sound CSR-1001 (distributed by Nautilus), $16.50.

This is a jazz album in the truest sense. Since there was only one take and much of the music is improvisational, the disc is a unique, virtually live performance. You can practically see (and certainly hear) each musician "step out" and do his or her own thing. If you're used to records with lots of special effects and cut-ins and exaggerated channel separation, you may find this album toned down. Personally, I felt it alive, exciting and true. The style reflects the Brazilian and "funk-rock" influences, not exactly my bag, but if it's yours I highly recommend this disc.

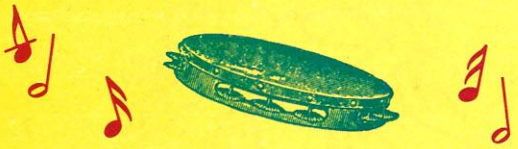
Victor Feldman is ably supported on this disc by Hubert Laws on flute, Harvey Mason on drums, Chuck Domanico on bass and Fred Tackett on electric and acoustic guitar.

Prokofiev: Love for Three Oranges Suite, Ravel: La Valse, DeFalla: Dance from La Vide Breve. London Philharmonic Orchestra, Walter Susskind conducting. Crystal Clear CCS 7006. $14.95.

Susskind's direction in a word can be called competent—completely and totally. Perhaps not the flair of Bernstein or precision of Steinberg, but one is left with the feeling that the piece is heard exactly as the composer intended. No extra flourishes or embellishments, but rather a perfection of style and blending of the instruments that is a perfect combination with the direct recording technique.

It's a pleasure to get away from the sound spectacular records that many of the digital and direct-disc companies apparently felt compelled to release initially (and which we choose not to review). Here instead is music that can be listened to over and over and is that much more pleasurable for the excellent quality of the performance as well as the disc itself. A minor point: we were not impressed with the extremely short jacket notes.

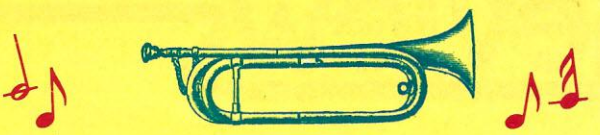
A complete catalog and description of the direct-disc process is available free from Crystal Clear Records, Inc., P.O. Box 3864, San Francisco, CA 94119. Mention Creative Computing.



Gould: Spirituals for Orchestra and Foster Gallery. London Philharmonic Orchestra, Morton Gould conducting. Crystal Clear CCS 7005. $14.95.

It's a pity that these Gould compositions aren't performed more often. Apparently they're not "serious" enough to get in the repitoire of most orchestras, not even the New Jersey symphony. A pity, because the pieces are beautiful. Spirituals is not variations on negro spirituals as one might expect; rather it is loosely related to the jazz and black folk idioms, yet in spots it also reflects protest and struggle while in other spots triumph and celebration are stated with brassy gusto.

Gould's conducting of his own compositions ensures that we are hearing them exactly as the composer intended. The sound quality is superb. It is particularly apparent in the mid-ranges although the bass drum down around 30 hz. has to be the spectacular highlight of this disc.



Seventeenth Century Italian Music, Vol. 1. The London Early Music Ensemble, Christopher Hogwood conducting. Gale GMFD 1-76-001. $14.95. (Distributed by Audio-Technica U.S., 33 Shiawassee Ave., Fairlawn, OH 44313. Mention Creative when writing for their catalog).

While one buys a record for the music, we feel that jacket notes should not be ignored. In this case, the record is packaged in a fat box along with a 12-page book of notes on the compositions, instruments, performers and recording technique. It's on heavy tan paper and certainly grabs your attention.

As for the record, it is excellent. The music is divided between Renaissance and Baroque. The earlier pieces tend to be based on vocal folk music and one can almost see a singer and a few players merrily coming into a pub to offer a few ditties.

The instruments are fascinating to read about: how about a cornett made from two gouged-out halves of plum wood glued together and covered with black leather. The tones are unique and spectacular but not overwhelming. The sense of presence is compelling and the music entertaining but your sound system (for all these records) had better be up to it. One band on this disc, for example, was beyond the capabilities of my cartridge. □

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Reviews

Microprocessors: From Chips to Systems, by Rodnay Zaks. Sybex Inc., 2161 Shattuck Ave., Berkeley, CA 94704. 416 pages, paperback $9.95. 1977. (Available from Creative Computing).

Les Microprocesseurs (Techniques et Applications), by Rodnay Zaks and Pierre Le Beux. Sybex Inc., 319 pages, paperback $16.95. 1977. In French.

Here's a book that, in English, will teach you all about the basics of microprocessors, without any preliminary knowledge of computers, although you'll need "a basic engineering knowledge." And if your languages include French in addition to BASIC, COBOL or whatever, here's your opportunity to add a vocabulary of computer words, such as "entree-sortie" for I/O, and "octet" for byte.

These books move at a quick pace and are recommended more for future bit-hackers than neophyte dilettantes. The text is full of block diagrams and quite technical explanations in the ten chapters, on fundamentals, internal operations, system components, comparative microprocessor evaluation, system interconnect, applications, interfacing, programming, system development, and "the future."

The 8080 is examined in detail, and other microprocessor, memory and interface chips are also discussed, from AMD to Zilog.

The engineering-level text, although not quite at the level of the Osborne books in difficulty, is thorough, practical, and full of those little extras that show Zaks has had a lot of teaching experience and knows what nooks and crannies need to be filled.

The French edition uses the same illustrations, including some that are not translated from the English, and the text is a little longer in some places. The translation is not word-for-word, and differs here and there, perhaps because different audiences are being addressed. The book ends with a dictionary of microprocessor terms in French, and a "microdictionnaire" of computer words in English and their French equivalents.

How to Profit From Your Personal Computer, by T.G. Lewis. Hayden Book Company, Inc., Rochelle Park, NJ. 198 pages, paperback $8.95. 1978. (Available from Creative Computing).

The title may be misleading, since the book does not show how you can make money with your computer. Instead, it "shows how to profit from your computer by putting it to work for you," as the back cover puts it.

Subtitled "Professional, Business, and Home Applications," this book shows how personal computers are used in applications such as mailing lists, accounts receivable, inventory, and payroll. Some computer-science fundamentals are also taught: binary arithmetic, programming, files, hardware.

The book is somewhat padded with anecdotes, usually pointless, at the beginning of each chapter, and with long prose sections leading up to why, for instance, Tom and Jeff need an inventory system in their motorcycle shop. Fortunately there is a minimum of this, and the book has a lot to offer to a reader with a quick mind and a head for math. And it wouldn't hurt if he had a good knowledge of BASIC too, because BASIC is not taught in this book, and some of the programs are rather complex, such as for multiple-listing-service information retrieval, in a real-estate application.

In a last crystal-ball chapter, the author predicts the personal computer of 1994 will speak and listen in limited fashion, might see through a TV camera, and thus "will be as near to a robot as we can imagine (even though it will not be mobile or look human)." Any bets?

Beginning BASIC, by Paul M. Chirlian. Dilithium Press, 30 N.W. 23rd Place, Box 10766, Portland, OR 97210. 232 pages, paperback $9.95. 1978.

Here's a book that should be a winner. It is packed with information, has little if any padding or unnecessary "white space," and covers BASIC quite thoroughly and simply.

Yet it somehow doesn't come up to the level of several other books on BASIC, on points that may be trivial but which may just turn off some readers. For one thing, the book has many pages that are almost solid type, with no spaces to set off the programming examples.

The style is too formal and in some places too wordy. The chapter on Vector and Matrix Operations opens with, "There are special statements in the BASIC language that enable us to manipulate matrices easily. We shall discuss them in this chapter." What does that second sentence add to the chapter?

A curious feature is the use of a slash through the letter O, "in order to distinguish the letter O from the digit 0," but which is the exact opposite of what computers use today. Not only that, but the sign used is a circle with a diagonal slash through it, the diameter sign used in engineering, not a letter O with a slash. So the programming examples look rather weird, with the REM statements looking not-quite-Greek, not-quite-Scandinavian.

These are all trivial, yet the book, with the help of an industrious editor, could have been made much more readable. The basic ingredients are all here: a full discussion of the language with short programming examples, flowcharts where needed, many good exercises at the end of each chapter. And yet....

8080A/8085 Assembly Language Programming, by Lance A. Leventhal. Osborne & Associates, Inc., Box 2036, Berkeley, CA 94702. 494 pages, paperback $7.50. 1978.

Here's another excellent Osborne book, fully packed with information, all meat and no padding, written by an expert. The pace is fast, but if you're a real bit-hacker, there's probably no better book on the subject.

Leventhal takes about 160 pages to introduce assembly-language programming and to examine the 8080A and 8085 instruction sets in detail. From then on, it's mostly examples and applications, with chapters on Simple Programs, Simple Program Loops, Character-Coded Data, Code Conversion, Arithmetic Problems, Tables and Lists, Subroutines, Input/Output, Interrupts, Problem Definition and Program Design, Debugging and Testing, Documentation and Re-Design, and Sample Projects.

Most of these chapters give examples, and then give problems for the reader to solve with an assembly-language program, which he should then execute on an 8080A or 8085-based microcomputer system "using the examples as guidelines."

Dr. Leventhal's experience and expertise as a teacher is evident throughout this text, with a great deal of helpful information given, far above and beyond the bare bones many other authors of similar texts have been content to provide.

32 BASIC Programs for the PET Computer, by Tom Rugg & Phil Feldman. Dilithium Press, Box 92, Forest Grove, OR 97116. 284 pages, paperback $15.95. 1979.

This is one of the best books Dilithium has ever published, and is recommended to all PET owners and to anybody who wants to see how a book of personal-computer programs should be written.

The 32 BASIC programs are divided into six sections: applications programs (biorhythm, checkbook, loan, etc.), educational (arithmetic, vocab, metric), games (obstacle, Wari), graphics display (KALEIDO, SPARKLE), mathematics (least-squares curve-fitting, area under a curve), and miscellaneous (approximation of pi, powers, etc.). Each section contains four to six programs; only a few are named here.

For each program, there are sections on its purpose, how to use it, a sample run (photo of screen or printout or both), program listing (from the original printout), easy changes, main routines (instead of REM lines, the authors describe the function of each group of program lines, separately from the program), main variables (a listing, with meanings), and suggested projects.

There's a wide variety of programs, with something for everybody. The graphics programs show great ingenuity, and the "suggested projects" sections should be of interest to science-fair entrants.

The entire book is very well designed, as well as being full of information that will certainly provide a maximum of entertainment and education to any PET owner.

The programs are available from Dilithium on cassette, at $9.95 for each of the five cassettes (graphics display and miscellaneous are combined in one), or $44.77 for all five.

The Home Computer Handbook, by Edwin Schlossberg, John Brockman and Lyn Horton. Bantam Books, New York. 253 pages, paperback $2.95. 1978.

If you're turned on by gee-whiz-ain't-computers-wonderful books, this may be for you. That is, if you like a book cobbled together from various bits and pieces that don't hang together very well.

There's a great deal here about what computers are going to do for you in the future, and chapters about the binary system, key words for home computers, and on programming languages. But the chapter on languages, as is typical in this book, doesn't contain a single program, not even one line. However, it does tell you that LISP is an interpretive language.

There are a couple of passages of value in this book, but the reader must wade through much excess verbiage to find them. Most of the material added to pad out the book is a waste of space, such as the "Buyer's Guide" that gives so little information on each system as to be next to useless, and includes many computers that no hobbyist would ever buy, such as the Hewlett-Packard HP9831A, plus some computers that have never been available, such as the Micro-Sphere 200. The 9½-page listing of peripherals is a complete waste, since only model numbers are given, nothing more.

The appendix on "Home Computer Books" lists a great many books most hobbyists would never read. And so on, and on, to the last appendix, "The History of the Computer and the Home Computer, " which contains only one sentence about home computers, and that one is a platitude, like so much else in this book, which you can easily do without.

Peanut Butter and Jelly Guide to Computers, by Jerry Willis. Dilithium Press, 30 N.W. 23rd Place, Portland, OR 97210. 214 pages, paperback $7.95. 1978.

In addition to having a title that's sure to drive librarians crazy, this book is an uneven mixture of good and not-so-good portions, as are most of the beginners' guides to personal computers.

One of the good chapters is the last, "What Delivery in 30 Days Really Means." But some of the other chapters get much more heavily into the technical details than most beginners may find of interest. Such as the table showing the EIA name and description of all the RS-232C pin numbers. Or the chapter on programming, Do You Speak Computerese?, which spends much more time on machine language and binary numbers than on BASIC.

Another good chapter is called A Day in the Life of Some Typical Computers, even though the title is totally misleading. It's not about how a computer might be used during an average day, but is simply a catalog, with comments, on various computers. This one chapter is probably the best in the book, since it could help a reader decide which machine to buy.

In the chapter on Can Computers Really Do It Better?, the author falls in with the pie-in-the-sky thinking that "the computer, for example, might detect a potential problem developing because of unexpected medical bills and print out a warning..." to modify the family's spending.

All in all, this is as good as most other books on the subject, which isn't saying much, and better that some. But a much lighter touch is needed, and there's much more technical information than the average beginner will care for. This is more for the budding computer freak, who could well devour every word and ask for more.

A Simple Guide to Home Computers, by Steve Ditlea. A&W Publishers, Inc., 95 Madison Ave., New York, NY 10016. 220 pages, paperback $4.95, hardcover $10.95. 1979.

Although this is one of the better home-computer guides, it too has a gee-whiz opening, as well as a computer-Utopia ending.

After we're told how your home computer will someday be able to fill in your Form 1040 for the IRS, and water your lawn while you're on vacation, the author gets down to the serious side of things and does quite well. Except for getting into several areas more deeply than most beginning computerniks may want to delve, such as the history of the commercial computer, a binary adder, and the manufacture of microprocessor chips.

The best part of the book starts on page 90, with chapters on the characteristics of home computers, programmable video games, compact home computers, keyboard mainframes (mainframes??), component systems, and a very good 18-page introduction to BASIC.

The epilog, after discussing the future of devices such as bubble memory and liquid-crystal displays, gets into one of those "how my computer plays such a large part in my day" plots, from wake-up routine through language lessons and automated showers, to a computerized town meeting. The author does end realistically, however, with words about the Big Brother problem, a quote from Stan Veit of New York's Computer Mart that "There isn't anyone who **needs** a home computer," and the remark that "It would be a tragic waste of resources to produce a wave of home computers that are just televisions with letters, numbers, and graphics."

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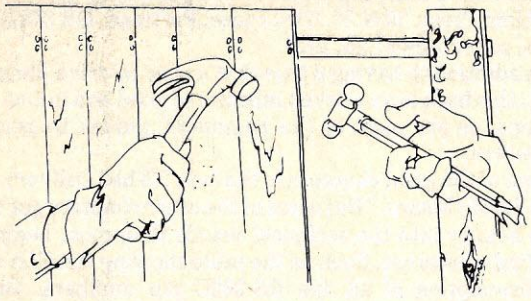

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Introduction to BASIC, Digital Press. Digital Equipment Corp., Boston, MA 02107. $5.50.

Not being a particularly world famous math wizard or internationally known programmer, I have for the last year been trying to teach myself BASIC. I service computers for a living but when it comes to software I know only enough to be dangerous. I can go through the code of several machines and higher level languages and follow what the system is trying to do. But to sit down and to creatively write a program of more than five lines I need help. Not having the time or desire to take a formal course I have been practicing my BASIC while testing the system I am working on. I have recently purchased a PET so I can now begin to practice in earnest. The method I started with was to take program listings from the hobby magazines and convert them to the PET. You can learn a great deal debugging programs like this but many times I have wondered why a particular statement was there or what it did.

But for us dummies not up to creating a new three dimensional Star Trek there is new help on the scene. The book INTRODUCTION TO BASIC published by Digital Equipment Corporation Press is well written, well documented and contains examples a nonmath-oriented person can understand and find helpful.

For those of us with home computing interest the book does have one drawback. It was written primarily for Digital's RSTS/E operating system; and, therefore, contains some things that don't apply to my PET. Those shortcomings are far outweighed by the books positive points.

Included is some background information on computers, what they do and how in general terms they do it. Of particular note is a very basic review of numbering systems which most of us forgot in high school. Chapters cover such topics as line numbers, print statements, numbers (constants and variables), flowcharting, and program organization. One whole chapter is dedicated to interacting with BASIC or "what to do after you hit carriage return." Chapter four is where the real fun begins. Subject matter included in the next few chapters is subscripts, arrays, dimensions, subroutines, and a step-by-step trip through math functions as BASIC handles them.

I have thus far skipped over the real reason I think the book is so outstanding: easy to understand detail. The book will take a five line program and spend two pages tearing the program apart telling you what each statement line does and why that function was used. This, in my opinion, is what makes this book one of the best on the market.

As a little sidelight, Digital has assembled a group of people in their publishing department whose entire function is to make sure that material is easy to read with no double meanings. If the word rabbit is used as an example it will be used four hundred times if necessary rather than changing to hare halfway through. This book reflects that easy to read attitude.

Larry Watkins

The BASIC Handbook by David A. Lien. Compusoft Publishing Co., P.O. Box 19669, San Diego, CA 92119. 360 pages, softbound $14.95. 1978.

The subtitle of The BASIC Handbook is "An Encyclopedia of the BASIC Computer Language" and that is certainly appropriate. This is the type of informational BASIC guide that has been needed for a long time. The author, Dr. David A. Lien, is also responsible for the Level I Manual which is supplied with each TRS-80 computer sold by Radio Shack. In

fact, that manual is such a good BASIC learning textbook that it is now available as a separate item at most Radio Shack stores.

The BASIC Handbook is not a textbook. It is an encyclopedia and is intended to be used as such. In other words, it is a descriptive listing of BASIC words, over 250 of them. Each word rates one or more pages. When you run upon a word in a BASIC program and you're not sure what it does, a quick trip to The BASIC Handbook should supply the answer.

BASIC words are divided into four catagories. They can be Commands, Statements, Functions, Operators, or a combination of the categories. PRINT, for instance, can be a Command or a Statement on most machines. Each word starts out with a description of its normal usage. Some unique words will be found in only one particular version of BASIC and this is indicated where that is true.

Next is a listing for a test program. You type and run the test program and the result will tell you whether that particular word works on your machine or not. For instance, the test for the ASC function will print "ASC PASSED THE TEST" if it did indeed pass the test.

In some cases, more than one test program is provided to test the word under various conditions. You might want to test with a numerical variable and a string variable to make sure that it works both ways. After each test program a Sample Run is printed.

Hints as to usage and variations are then provided. Some versions of BASIC might use a given word in one way and other versions might give it another meaning. When appropriate, specific versions of BASIC are mentioned by name, i.e., Level II, Cromemco 16K, PT Extended Cassette, Apple, etc.

If it is possible to write a subroutine to perform the same function as some word that you need but don't have, then this information is given. The BASIC word ASN is used to compute the Arcsin in radians. Your computer doesn't understand ASN but you can use the subroutine listed to achieve the same results.

Finally, a listing of related words is provided. These are words that perform similar functions or that give information which might help you to better understand the word under discussion.

The words in The BASIC Handbook are listed in alphabetical order. After all of the words have been treated there is a section providing the same information for operators. These include punctuation (. " ? ; : ,), mathematical signs (- + * /) and comparisons and assignments (= < >).

An enormous amount of information is packed into 360 pages. If you have a pretty good understanding of the particular BASIC running on your machine, then The BASIC Handbook will probably not help you to write better programs. However, where it really shines is in the conversion of programs from one version of BASIC to another.

I'm sure that all of you have come across many programs in the personal computer magazines that you would like to use but pass up because they contain words that your machine can't interpret. I know that I have. Now, except for programs that call for physical operations or peripherals you don't have, you should be able to translate, ENTER, and RUN any program you like with The BASIC Handbook by your side.

Rod Hallen

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Softbound, 386 pages, $11.95 plus $1 shipping and handling in U.S. ($2 foreign).

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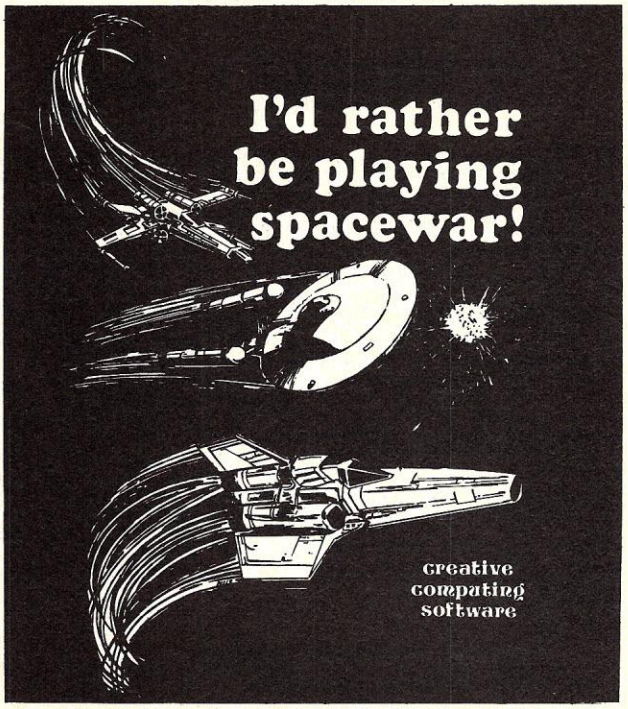

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The Consultant, by John McNeil, Ballantine Books, New York, NY. 297 pages, paperback (fiction) $2.25. 1978.

Hired to investigate a large commercial bank's electronic funds transfer system, consultant Christopher Webb uncovers someone fiddling with the system. But who? Obviously only a very few people have access to live customer data and none of them are in a position to modify the computer programs to set up bogus accounts. Painstakingly, Webb tracks the culprit via several conflicting core dumps and unexplained holes in the Banknet operating systems. He finally uncovers the method used and the criminal. But then he turns around and raises the stakes by leaving the fiddling programs intact and lays plans to use it himself.

Could the fiddling programs, the "Weevil" as Webb calls them, been found by examining core dumps? Personally I doubt it, at least not in the way described in the book. Also, I personally don't think much of making a criminal, even a white collar one, the hero of a book. Maybe I'm a throwback, but white and black—good and evil—honesty and crooks—with honesty coming out on top still appeals to me. Despite these shortcomings, McNeil tells an intriguing story that will have you staying up flipping pages until you reach the (surprising?) ending.

—DHA

APL: An Introduction, by Howard Peelle. Hayden Book Company, Inc., New York, NY. 256 pages, paperback, $8.50. 1978.

This friendly, "self-teaching" book is exactly what the title says. It introduces you to each of the features and concepts of APL in a patient way, with lots of little "self-tests" to keep you on the right track. It is not, on the other hand, an introduction to problem solving (i.e., programming).

The material unfolds in a reasonable order. It begins with the things you would want to know first, like how to get anything at all to happen. Next, a small collection of simple operators are introduced, giving a feeling for the (unusual if you're used to BASIC) nature of APL statements. Chapter 2 introduces the concept of program definition, plus some more APL operators. The next chapters describe the details of expression evaluation, branching, function application, arrays and operations on them, and the rest of the APL primitives. In all, there are nine chapters, plus a section called "APL Bogglers"; a concise summary of APL features and concepts; and appendix giving the answers to the self-tests; and an index.

Each of the nine chapters has this organization: down the left side of the page are APL statements and their results; down the right side are handwritten notes, explanations, and comments. Peelle definitely has a way with the self-teaching style—as I went through the material, I felt a steady progress in understanding, and each time I had a question, it was soon answered. When I picked up this book, I had only a casual acquaintance with APL. By disciplining myself to really try the self-tests before I looked at the answers, I gained a real feeling for the basics of using APL.

If you're planning to get a system with APL, this book would be a good one to go through even before your system arrives.

Rich Didday

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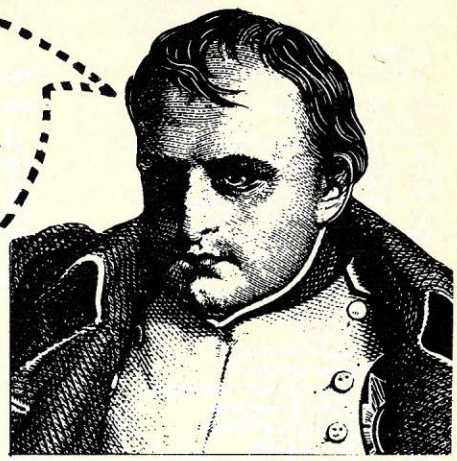

Programming in BASIC

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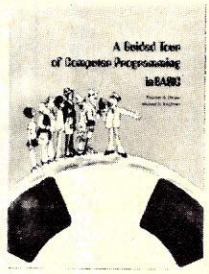

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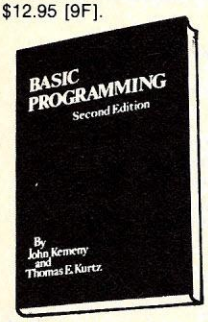

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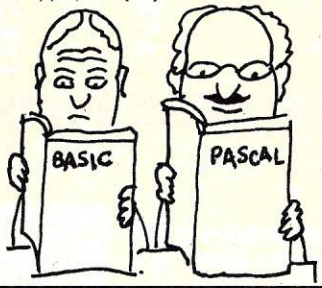

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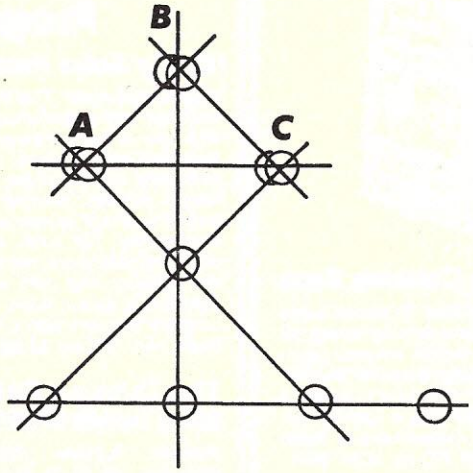
Puzzle Answers.

1. The Square of Samarkand

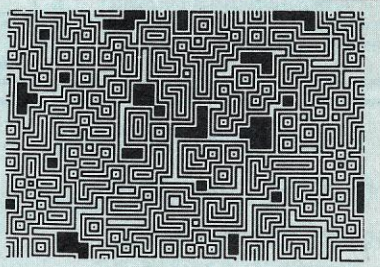
4	1	3	0	2
3	0	2	4	1
2	4	1	3	0
1	3	0	2	4
0	2	4	1	3

2. There were 729 cubes in each.
3. The solution, of course, requires that the location of the camp be determined. There are two possible locations. The North pole and a set of locations near the South pole (so that traveling one mile due east returns you to your starting point). There are no bears near the South pole so the bear must have been a polar bear. The answer is "white". (Note: at any other location the distance back to camp would have been more than 1 mile).
4. The tracks in the snow were made by a man with a peg leg pushing a wheelbarrow.
5. Double coins are placed at intersections A, B, and C.



6. Substituteas follows: a = 2, b = 11, c = 8, d = 1, e = 14, f = 4, h = 13, i = 5, and j = 9.

What we see in life depends mainly on what we look for.
Lubbock



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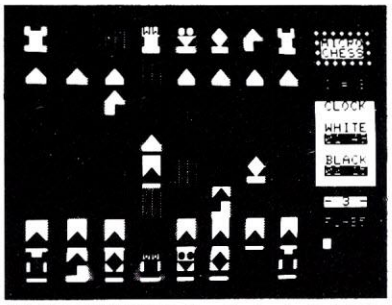

MICRO CHESS

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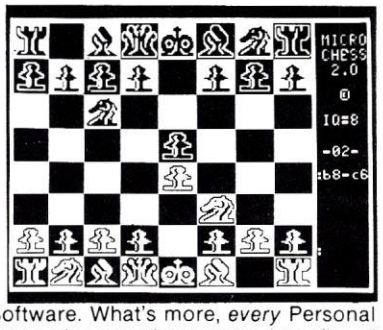

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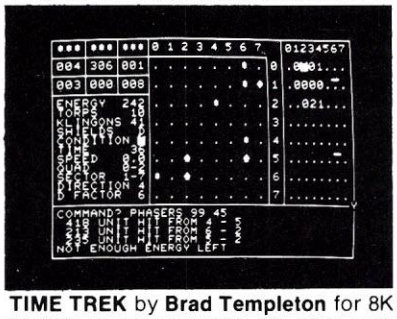
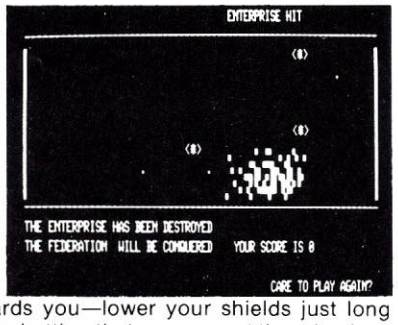


TIME TREK

A Tour De Force In Real Time Action Strategy Games



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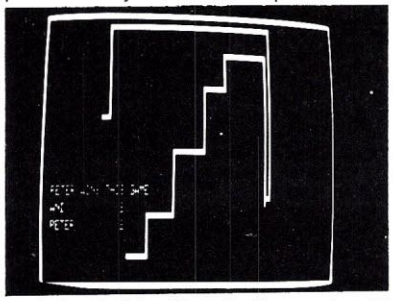

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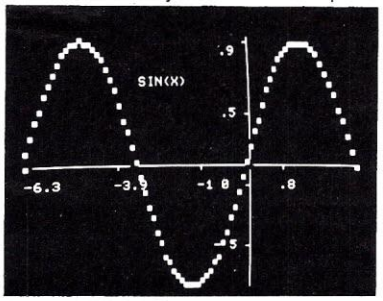
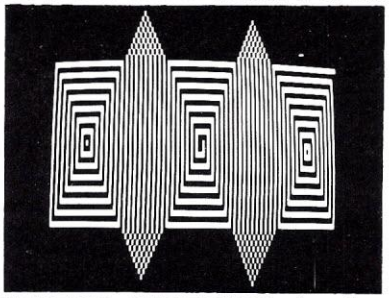


GRAPHICS PACKAGE by **Dan Fylstra** for 8K **PET**s includes programs for the most common 'practical' graphics applications: PLOTTER graphs both functions and data to a resolution of 80 by 50 points, with automatic scaling and labeling of the axes; BARPLOT produces horizontal and vertical, segmented and labeled bar graphs; LETTER displays messages in large block letters, using any alphanumeric or special character on the PET keyboard; and DOODLER can be used to create arbitrary screen patterns and save them on cassette or in a BASIC program **$14.95**



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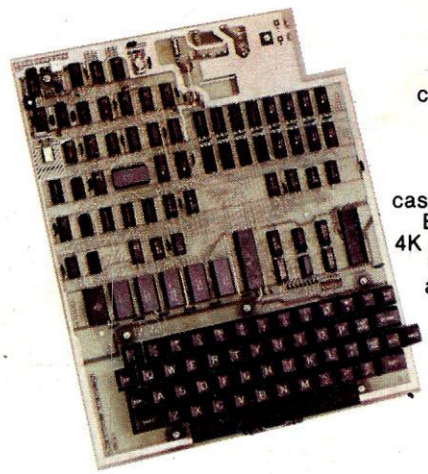

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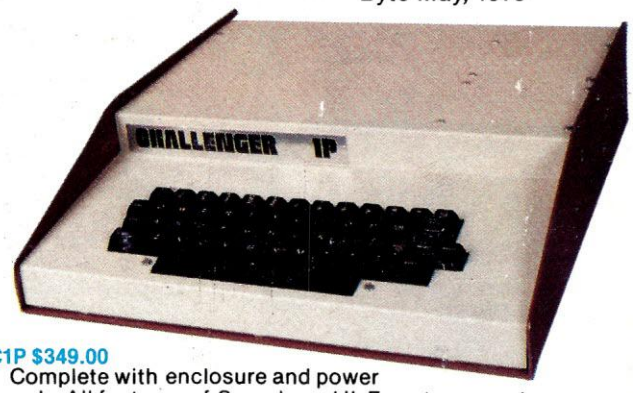

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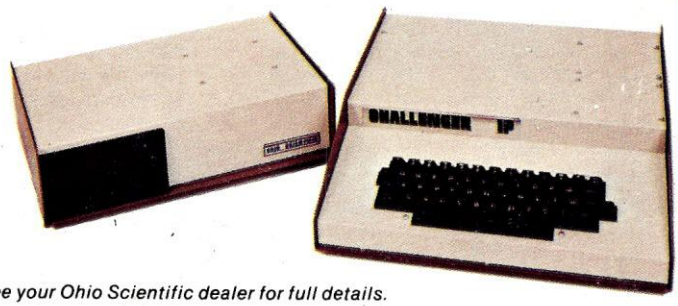

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